U.S. ARMY HAWAI`I STATEWIDE OPERATIONAL NOISE MANAGEMENT PLAN

September 2010

Prepared By:

Operational Noise Program
Directorate of Environmental Health Engineering
U.S. Army Public Health Command (Provisional)

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Directorate of Environmental Health Engineering
U.S. Army Public Health Command (Provisional)
5158 Blackhawk Road
Aberdeen Proving Ground
Maryland, 21010-5403
410-436-3829

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EXECUTIVE SUMMARY

OVERVIEW

The Statewide Operational Noise Management Plan (SONMP) provides a review of the current and future noise environment for the United States Army Hawai`i (USARHAW). The SONMP provides a methodology for analyzing exposure to noise associated with military operations and provides guidelines for achieving compatibility between the Army and the surrounding communities. The Army has an obligation to U.S. citizens to recommend uses of land around its installations that will: (a) protect citizens from noise and other hazards, and (b) protect the public's investment in the installation.

The noise impact on the community is translated into noise zones. The program defines four noise zones. Noise Zone I (NZ I) is compatible with most noise-sensitive land uses. Noise Zone II (NZ II) is normally not recommended with noise-sensitive land uses. Noise Zone III (NZ III) is not recommended with noise-sensitive land uses. The Land Use Planning Zone (LUPZ) provides the installation with a better means to predict possible complaints and meet the public demand for a better description of what will exist during a period of increased operations. These zones exist as noise zone maps within the SONMP.

CONCLUSIONS

Although there are many activities on the USARHAW property with diverse missions, and a wide range of operations, the primary sources of noise are generated through large caliber weapons and demolitions, small arms, and rotary wing aircraft training.

Schofield Barracks Military Reservation (SBMR):

According to Federal guidelines, there are no incompatible land uses off post within the annual average C-Weighted Day-Night Level (CDNL) Noise Zone II and Zone III. There are, however, non-recommended land uses on post within the SBMR's Residential Communities Initiative (RCI) housing area resulting from both small arms and large caliber and demo training.

The complaint risk guidelines indicate a moderate probability (115-130 dB) of receiving noise complaints in the town of Wahiawa resulting from large caliber weapons and demolition training. On post, the high risk of complaints (>130 dB) noise contour overlaps the RCI housing area.

Schofield Barracks East Range (SBER):

The town of Wahiawa is close enough to the SBER that firing of blank rifles may at times be audible to the residents. A 100 meter "buffer" of forest lies between the training areas and Wahiawa, thus noise levels may be slightly lower than predicted.

Wheeler Army Airfield (WAAF):

There are no incompatible land uses off post within the Zone II or Zone III noise contours. There are, however non-recommended land uses on post within the WAAF RCI housing unit resulting from Wheeler aircraft operations.

For the Land Use Planning Zone (LUPZ), the areas of concern are the RCI Housing at SBMR and a small residential region of Mililani Town. On post, the areas of concern are the WAAF RCI Housing and Wheeler Elementary and Middle schools.

There is the potential for aircraft to cause annoyance while entering / exiting the airspace. Pilots at WAAF should continue with noise abatement and no fly zones procedures found in section 6.3 (Aircraft Noise Abatement).

The recent Aviation Brigade request to for an additional hour (2200-2300) will have a minimal effect on the noise zone contour found in Figure 4-2, though single events could cause alarm with nearby neighborhoods. Pilots should be aware of noise sensitive areas and practice established noise abatement procedures.

Pilots should also be informed of the "Fly Neighborly' program and guide which is found at:

http://www.rotor.com/portals/12/Fly%202009.pdf

Makua Military Reservation (MMR):

For both the highest projected (50 Combined Arms Live Fire Exercise (CALFEX)) and reduced (32 CALFEX) training activity, the Zone III noise contour would overlap the Makua Beach recreational area. This land use would not be recommended for the noise environment. For consideration, the hours of live-fire training at MMR would typically occur in the early morning and evening hours and less of an impact when compared to long term residential areas.

Public notification using available media before training exercises generating high noise levels could minimize the short-term adverse CALFEX annoyance impact on beach goers. [1]

Kahuku Training Area (KTA):

The town of Sunset Beach is in close proximity to KTA. If small arms blank training is conducted in the western portion of the training area, the firing may at times be audible to the residents of Sunset Beach.

There is the potential for aircraft to cause annoyance while entering / exiting the KTA airspace. Pilots utilizing KTA should continue with noise abatement and no fly zones procedures. No fly zones near the KTA boundary are found in Section 8.5

[1] Draft Environmental Impact State, Military training Activities at Makua Military Reservation, March 2005

Kawailoa Training Area (KLOA):

There are no incompatible land uses off post within the PK15(met) Noise Zone II contour resulting from small arms blank training. Due to the mountainous terrain of KLOA, actual levels existing beyond the training boundary may be less than predicted.

There is the potential for aircraft to cause annoyance while entering / exiting the KLOA airspace. Pilots utilizing KTA should continue with established flight routes, noise abatement procedures, and no fly zones. No fly zones near the KLOA boundary are found in Section 9.5.

Dillingham Military Reservation (DMR):

There are no incompatible land uses off post resulting from small arms (blank) training at DMR.

Pilots utilizing Dillingham Airfield should continue with established flight routes, noise abatement procedures and no fly zones. Flight restrictions and no fly zones near the Dillingham Airfield are found in Sections 10.5.

Pohakuloa Training Area (PTA):

There are no incompatible land uses on or off post resulting from small arms training within the PK15(met) Noise Zone II and Zone III.

There are no incompatible land uses on or off post resulting from large arm and demo training within the annual average C-Weighted (DNL) Noise Zone II and Zone III.

The complaint risk guidelines indicate an extremely low probability off post though there would be a moderate risk on post in the PTA building and office area.

Bradshaw Army Airfield (BAAF):

The low number of military aircraft utilizing the flight corridors at BAAF will not generate A-weighted Day-Night average sound Level (ADNL) noise contours. Yet, there is the potential for aircraft to cause annoyance and possibly generate noise complaints while entering / exiting the airspace.

Pilots utilizing BAAF should continue with established flight routes, noise abatement procedures and no fly zones. Noise abatement procedures are found in Section 12.5.

Noise Complaints Procedures:

In accordance with Army Regulation (AR) 200-1, the USARHAW has implemented a noise complaint management program. The Public Affairs Office (PAO) has been proactive in addressing noise complaints and local public concerns which include monthly board meetings in the following areas: Waianae, Ko'olauloa, Wahiawa, Mililani Mauka / Lanunani Valley, North Shore, Mililani / Waipio / Melemanu, and Nankuli.

The phone number for noise related complaints is **# 808-656-3159**. This number is for the PAO, Community Relations for the U.S. Army Garrison - Hawai`i. Calls received are handled without delay and the complainant is informed of the USARHAW mission and that every effort will be made to correct the problem, mission permitting.

The USARHAW will continue to build its noise management program to:

(1) Reduce potential incompatible land uses around testing facilities,
(2) Prevent detrimental effects on the mission, and
(3) Carry on the good-neighbor relationship with surrounding communities, and
(4) Record any future noise complaint with the Noise Complaint form found in Section 2.5

The USARHAW will continue to use the program to reduce the potential for noise complaints, caused by day-to-day operations through a responsive noise complaint procedure, and taking actions that are appropriate to guide future development of those properties adjacent to its boundaries.

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1.0 INTRODUCTION

1.1 GENERAL

One of the goals of the Department of the Army (DA) is to establish effectual programs designed to minimize the Army's adverse impacts upon the quality of the human environment without impairing continued success in the Army's mission. In keeping with this goal, the Army established an Operational Noise Management Program (ONMP) as the framework for the management of noise produced by Army activities since noise has been determined by the United States Congress, as recorded in the Noise Control Act of 1972, to "present a danger to the health of this Nation's population" (PL 92-574, 1972). The primary tools for noise management are the Installation and Statewide Operational Noise Management Plans.

Note: The Operational Noise Management Plan(s) and Program were referred to as the **Environmental** Noise Management Plan (ENMP) and Program until the name was changed in 2004 in order to better describe the nature of the plan. Older plans, documents, or directives may still feature the word "environmental."

1.1.1 THE HISTORY OF NOISE MANAGEMENT IN THE ARMY

The advent of jet aircraft in the 1950's resulted in significantly greater noise levels around commercial airports that led to an intense outcry from the public. This backlash caused congress to revise the Federal Aid to Airports Act to make Federal aid contingent upon implementation of programs to resolve noise problems with surrounding neighborhoods. Subsequently, Congress passed the Noise Control Act of 1972 and the Quiet Communities Act of 1978. Under these laws, airports and local communities carried out noise control measures such as revising zoning laws, altering real estate transaction requirements, purchasing buffer lands, and changing approach, departure, and run-up protocols. As a consequence, the Federal Aviation Administration (FAA) currently has specific requirements for community involvement in all airport planning.

The Noise Control Act and the Quiet Communities Act contained language outlining the responsibilities of Federal Agencies in protecting the public from unreasonable noise impacts. Specifically, these laws state that:

> *"Federal agencies shall, to the fullest extent consistent with their authority under federal laws administered by them, carry out the programs within their control in such a manner as to … promote an environment for all Americans free from noise that jeopardizes their health and welfare.*

To comply with the intent of Congress, the Department of Defense (DoD) provided guidance to the military departments regarding the compatible use of public and private lands in the vicinity of military airfields. The DoD guidance (DODI, 1977):

- Defined restrictions on the uses and heights of natural and man-made objects in the vicinity of air installations.

- Defined restrictions on land use in the vicinity of air installations to assure compatibility with the existing characteristics, including noise from military operations.

- Provided policy as to the extent of the U.S. Government's interest in retaining or acquiring real property to protect the operational capability of active military airfields.

As a matter of general policy, the military departments were instructed to work toward achieving compatibility between air installations and the neighboring civilian communities through a compatible land use planning and control process conducted by the local civilian community.

Based upon DoD guidance, the DA then developed its ONMP that addresses noise from all military activities, not just airfields. The Army's program is designed to (U.S. Army, 1997):

- control environmental noise to protect the health and welfare of military personnel and their dependents, Army civilian employees, and members of the public on lands adjacent to Army, Army Reserve, and Army National Guard installations; and

- reduce community annoyance from environmental noise, to the extent feasible, consistent with Army, Army Reserve, and Army National Guard training and materiel testing activities.

1.1.2 THE ENCROACHMENT RISK

Military installations almost always tend to attract activity from the civilian sector because with government activity come economic benefits. When people arrive to work at these installations, they soon need housing, grocery stores, restaurants, and other support facilities, and businesses crop up to meet that demand. At this point, the relationship between the adjacent town and the installation is in harmony (because one could not exist without the other), and each tend to over-look the other's inconvenient characteristics.

What ultimately can happen is that the town that springs up next to the installation eventually matures and acquires an economic momentum that is independent of the installation. As the town becomes less reliant on the installation as its economic lifeblood, those inconvenient characteristics (such as noise) that were over-looked in the past become less tolerable. New people moving into the area that gain their economic livelihood from areas other than the installation have difficulty understanding that the current location of the town near the installation grew from past ties that have long since been weakened or severed. This, coupled with the fact that increasing populations may also increase the outward sprawl of the town that at its inception originally may have been a comfortable distance away from the installation, ultimately leads to what is known as *encroachment*.

Encroachment is a complicated issue to solve, but an easy one to define. Simply put, encroachment is the process by which civilian issues impinge upon once-remote military installations. The simplest example of this is the physical development (particularly residential) of land directly adjacent to the installation whereby new residents become irritated by installation activities (primarily noise, but things like dust may also turn into contentious issues).

And, while noise is the focus of this plan, encroachment can take many forms. Examples include government entities passing endangered species legislation limiting where training may be conducted; air pollution regulations limiting something like dust; or a form of political encroachment that endangers the training mission when relations between countries shift and installations outside of the U.S. are altered or closed.

The endgame is that these processes can put severe limitations upon the ability of a military installation to support training and for assigned units to maintain an adequate level of readiness. And herein lies the threat as it relates specifically to this plan: as military noise impacts upon the civilian communities increase, so increase both litigation and/or political pressures which could result in degradation of the installation's mission. More specifically, not only does the number of complaints to installation commanders increase dramatically, but so do the number of complaints to elected officials.

One of the best examples of degradation of mission performance due to encroachment occurred at the Naval Air Station (NAS) in Los Alamitos, CA. As is typical of these types of situations, when originally established during WWII, this NAS was in a rural area. But, the post-war expansion of Southern California eventually surrounded it with homes to the point where the Navy could no longer routinely fly its jet aircraft into the property. Today, the Navy has left and the property now serves the California Army National Guard (CAARNG) and the U.S. Army Reserve which, compared to the Navy, operate relatively few noisy flights. In another highly politicized example, citizen outrage in 1999 over the noise and pollution of gunfire on Vieques Island (Puerto Rico) ultimately lead to the Navy's complete withdrawal from the island.

These situations are not limited to the Navy. In the Army's case, encroachment so severely limited the size of the explosives used at Fort Belvoir's (Virginia) Combat Engineer field training that it became necessary to move a portion of the training to a less urbanized area at Fort A.P. Hill, VA; but that too was only temporary. In the end, encroachment chased that entire engineer training school all the way to Fort Leonard Wood, MO. In another case, encroachment saddled Fort Dix, NJ with limitations on both the types of weapons that could be fired and the times of day.

A study published by the Army Environmental Policy Institute found that noise was the second most important threat (behind endangered species) to Army Range Operations (AEPI, 1999).

1.1.3 CONTENDING WITH THE RISK

In all of the above cases, limitations upon operational activities degraded the installations' capability to support essential training, so the training missions on these installations were then moved to other installations. For obvious reasons, this pattern cannot continue indefinitely.

The consequences of ignoring the conflicts between the noise generated on military installations and the desires of the civilian community regarding the use of the land surrounding these installations can be grave. If the military fails to respond to the concerns of the civilian community, the ill will produced by such an approach is quite likely to result in estrangement and a general unwillingness within the civilian community to work with the military to formulate creative land use ideas that allow communities and installations to exist in harmony. Worse yet, fomenting ill will can also result in the types of political pressure and lawsuits that force unilateral concessions on the part of the military without any reciprocal concessions from the community.

So in short, in order to prevent the conflicts between military operations and civilian land use from reaching significant proportions, the military (as a whole and individual installations) must take reasonable steps to protect the community from training noise, and it must work with the local governments and land owners to make sure that adjoining lands are developed in ways that are compatible with the noise environment.

1.2 THE ARMY'S OPERATIONAL NOISE MANAGEMENT PLAN

The primary strategies for working with communities to solve these issues of noise incompatibility are the creation and maintenance of community-supported long-range planning strategies for adjacent lands, and installation efforts to simply be a good neighbor. This is where the Army's Operational Noise Management Plans are valuable.

The plans come in two formats—statewide (SONMP) and installation-specific (IONMP) - and provide the installation(s) and land use planners with the following things:

- Accurate information needed at the planning table in order to solve encroachment problems including such things as computer-generated noise contour maps, planning strategies, examples of successes and failures at other installations, and basic economic information conveying the value of the installation to the community.

- Strategies for use on the installation(s) to limit, where feasible, the training noise that leaves the installation boundaries including altering training locations, maximizing the noise reduction at existing training locations, and implementing "good neighbor" programs that tailor training times to community needs.

- Guidance on proper complaint management procedures (logging, investigation, follow-up, etc.).

- Guidance on proper public relations procedures to minimize the overall chances of getting a complaint.

Note: These noise plans, while not intended for wholesale dissemination to the public, should be distributed to all applicable regional land use planners and be made available to interested individuals.

1.3 CONTENT

This report is divided into sections detailing the nature of noise, noise metrics and noise management; the overall noise environment for the installation; detailed descriptions of the noise generating activities at various locations within the installation, and ideas for lessening the noise emanating from these locations; strategies for addressing current and potential incompatibilities at adjacent lands; and various appendices providing more detailed information on methodologies, definitions, and other similar information.

More detailed information and publications on noise-related topics such as noise-level reduction in home construction, noise sciences, and computer modeling are available directly from the United States Army Public Health Command (USAPHC) Operational Noise Program. Please consult our website with questions or for more information:

http://chppm-www.apgea.army.mil/dehe/morenoise/

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2.0
NOISE MANAGEMENT

2.1 INTRODUCTION

Army installations are finding with increasing frequency that the land use around their boundaries is becoming incompatible with the noise generated by their training. A combination of factors has contributed to this trend, but it is primarily due to three elements.

First, the United States is in the midst of a relentless expansion of its population. When initially constructed, nearly all of the Army's installations were built in rural areas (unless its purpose was to defend a specific city or place) because it was where the land was cheap, there were few people to disturb, and secrecy could be maintained if needed. But, since 1940 the United States population has grown from 132,000,000 to its current (2005) estimated total of approximately 294,000,000 (U.S. Census Bureau). It is undeniable that all of these additional people must live somewhere, so the populations have been spreading into what were formerly sparsely inhabited areas.

Secondly, advances in technology have created ever more powerful weaponry with ever longer effective ranges. Together with that increasing power and range comes increasing noise and the need for larger and larger areas in which to test and train with them. In the past, when a new weapon was louder than its predecessor, few were around outside of the installation to notice a difference. Today, that is changing.

Lastly, both the military and local planners were late in recognizing the friction that the above two trends would cause. Thus, few plans to ensure compatible land use were made before the problems of encroachment arose.

The consequence is that, at an increasing number of installations, noise complaints are now a regular occurrence and must be managed so as to not jeopardize the training that makes the United States military the best prepared force in the world.

2.2 ENCROACHMENT AND NOISE COMPLAINTS

Noise from U.S. military operations is rarely loud enough to cause physiological and/or physical damage to the hearing or homes of populations adjacent to installation boundaries. Nevertheless, while there is no physical danger from these sounds, many find them irritating to the point where they are moved to complain about them. The complaints can be directed any number of places (friends, local media, government representatives, etc.), but the ideal situation is that the complaint comes to the source (the installation) so that it can be resolved in the best manner possible.

The most reliable way to ensure that this happens is for all installations to maintain the Noise Complaint Management Program required by Army Regulation 200-1 (AR 200-1), a copy of which is located at Appendix F.

2.2.1 THE NATURE OF ANNOYANCE AND COMPLAINTS

Annoyance (and thereby complaints) has its roots in both physical and psychological distress. Since military noise is rarely loud enough to cause physical distress, it follows that the vast majority of noise complaints that installations receive are due to some sort of psychological objection. Put another way, some people just do not like the "cracks" and "booms" and are sometimes irritated enough to complain about them.

The usual complaint pattern is as follows: First, economic activity unrelated to the installation stimulates increased population and development in the vicinity. Next, segments of the new population who are not economically dependent on the installation (or take issue with other aspects of the government presence) find noise to be a specific and undeniable object about which to complain. Finally, the people reporting the complaints become more articulate and eventually address their grievances to higher levels of government, politicizing the issue and endangering the mission.

The amount of annoyance that a particular sound elicits in an individual depends on a combination of many factors. At issue may be the characteristics of the noise itself such as the intensity and spectral qualities; duration; repetitions; abruptness of onset or cessation; and the *ambient noise* climate (or background noise) against which a particular event occurs.

But social surveys show that the following are also factors related to annoyance that have nothing to do with the characteristics of the noise itself:

- The degree to which the noise interferes with an activity.
- The previous experience of the community with the particular noise.
- The time of day during which the noise occurs.
- Fear of personal danger associated with the activities of the noise sources.
- Socioeconomic status and educational level of the community.
- The extent to which people believe that the noise output could be controlled.
- Beliefs about the importance of the noise source.
- General noise sensitivity.
- The amount and effectiveness of noise level reduction (NLR) features in the home.

Some of these the installation can do nothing about. But, others can be molded with carefully focused public relations efforts, and it is these upon which the installation's Public Affairs Office (PAO) should focus.

2.2.2 KEYS TO SUCCESSFUL NOISE COMPLAINT MANAGEMENT

A Noise Complaint Management Program is the system by which installations plan to deal with issues caused by noise. These issues range from the simple addressing of complaints, to advising local planning commissions, to plans of action to limit the future threat of encroachment. These programs may be administered by a single person at smaller or more remote installations, or an actual noise committee at larger installations or those with significant encroachment concerns. The size and scope of the programs are generally up to the individual installations, but noise should always be given enough consideration so that, due to lack of attention, what are small problems today do not grow into large problems tomorrow.

As stated, Noise Complaint Management Programs can vary from installation to installation based on the characteristics of the noise itself, the size of the installation, and the surrounding population. But, all effective programs share certain elements.

Foremost, all successful Noise Complaint Management Programs are built on the cornerstones of **integrity** and **sensitivity**.

It cannot be emphasized enough that people who lodge complaints must immediately be assured the installation cares about their concerns. This sensitivity to the feelings of complainants immediately helps to get to the root cause of the problem. For instance, many times complainants are less irritated by the noise itself than they are about the fact that it startled them or it interrupted their Sunday brunch. In these situations, simply listening in earnest to the complainant and explaining (to the degree possible given mission security) why the noise was necessary is enough to alleviate the irritation.

Integrity is related to sensitivity in that few people will believe the sincerity of the installation if they feel they are being misled. Consequently, when an installation makes a deal with the public (for instance, that there will be no firing before 0900 on Sundays), the installation must strictly keep its word in order to maintain credibility and the appearance that the installation is meeting the community half-way. This is not to say that the installation can never change procedures; but if it is necessary, it should be explained to the public why **before the change takes place.**

It is these little behaviors that cultivate goodwill and cooperation. Empathizing with the public's concerns creates an environment where information is exchanged more freely, ideas come forth more fluidly, and parties are more likely to make concessions in order to solve problems.

Within the framework of an integrity- and sensitivity-based management philosophy are other proactive tools that can be used to attack the problems of complaints:

Listening

The installation must listen to the community to find out exactly what is annoying them. It is not enough to simply assume that it is the noise. The installations need to find out what it is about that noise—the timing, frequency, a particular vibration, etc.—that is annoying the complainant. Once down to the heart of the matter, the complaint may sometimes be resolved with simple actions.

Informing

Information is the key to combating those factors leading to annoyance listed in the previous section. The more information the installation can provide to the public (without jeopardizing the mission), the more involved they will feel and the less likely they will be surprised by something. Providing the local news media with press releases (including a telephone number or website) when unusual operations are scheduled, or even when normal operations are to resume after a period of inactivity, can go a long way toward limiting complaints. And for their part, the news media must be monitored to ensure that the information is being released to the community in a timely manner. Also, designating a representative to attend community meetings is also an excellent way to keep the public informed and for them to associate a human face with the installation.

Responding

Of course, proactive efforts to establish a reputation for integrity and sensitivity mean little if the complaints the installation does receive are ultimately ignored. Accordingly, it is important to address complaints in a timely and polite fashion to lower the intensity of the situation. When the public is aware that each complaint is responded to quickly and courteously, the potential of the complainants organizing into citizen action groups (that complain to higher levels of command and government) is reduced considerably.

Still, to really understand issues of noise complaints and encroachment, one must first understand the basics of noise itself.

2.3 NOISE AND NOISE ASSESSMENT

Noise is simply unwanted sound.

The "unwanted" part of that definition is of course subjective to the receiver and dependent upon many variables that were touched upon in Section 2.2.1. But, properties of sound have been studied for hundreds of years in a branch of physics called "acoustics."

Note: This section is a highly simplified discussion. A more detailed discussion of sound is located in Appendix A, and as stated previously, the Army Regulations on operational noise are spelled out in AR 200-1, the noise portion of which is located at Appendix F.

2.3.1 THE SCIENCE OF SOUND

For the purposes of this plan, *sound* is the vibration of air pressure about a mean atmospheric pressure that is usually defined as 100,000 Pascals or 14.7 pounds per square inch (the standard atmospheric pressure at sea level). While all animals have different hearing ranges, these changes in the atmospheric pressure as they relate to human hearing vary from approximately 0.0006 Pascals for a whisper at two meters, to 1,000 Pascals for an M16 rifle at the shooter's ear. It has two basic parts: the energy (i.e., is it loud or soft?) and the frequency (is the pitch high or low?).

Because of this large effective range of sound pressure and the fact that the human ear responds more closely to a logarithmic scale (rather than a linear), the *decibel* system (dB) was developed to quantify sound energy (loudness) into a meaningful and manageable scale. On this scale, the range of average human hearing runs from approximately zero (the *threshold* of hearing) to 140 for a healthy human hear, though zero is by no means the absence of sound (some people may hear sounds as low as -10 dB). Interestingly, the non-linear characteristics of human hearing means that in the decibel scale, a 3 dB increase is roughly a doubling of sound energy, but it takes a 10 dB increase for something to actually sound twice as loud.

In the same vein, the human ear is not equally sensitive to all sounds in the entire frequency spectrum—it works most efficiently in the medium frequencies where speech is found. Thus, to make a sound measurement more meaningful, scientists have developed processes called *frequency weighting* whereby certain ranges where the ear is more sensitive are factored in more heavily than others where the ear is less sensitive. Consequently, when looking at decibel numbers it is important to recognize whether the measurements are weighted or *peak* (i.e., unweighted).

So, frequency weighting is in effect a type of filtering and, in the context of this plan, the two important filters are *A-weighting* (dBA) and *C-weighting* (dBC). A-weighting is used most often and particularly for higher frequency sounds such as transportation "hum." C-weighting is used for low-frequency events such as large arms and demolition explosions…the things that make a "boom." This weighting becomes important when creating the noise zones discussed later in this section.

Yet, there are other characteristics of sound that are important when determining how a sound becomes a noise. This is where the importance of the means of sound measurement (i.e., by what "yardstick") comes to the forefront.

2.3.1.1 SOUND PROPAGATION

When thinking about mitigation strategies, it should also be kept in mind that there are many factors affecting sound *propagation*, or the how and where of sound travel.

As stated, sound travels through air. So, anything that affects the density or composition of the air, or that interrupts the sea of air between the source and the receiver will have an effect on what sounds that receiver ultimately hears. This is a good news/bad news situation.

The good news is that the creation of physical barriers can do a great deal to reduce the travel of certain kinds of noise. These barriers can be as large as a berm or a wall near the source, or as tiny as a change in the insulation in the home of the receiver, and they can be quite effective at reducing complaints from the public. Due to their smaller wavelengths, physical barriers are most effective against high frequency sounds such as small arms fire and transportation sounds. Low frequency sounds from large arms and explosions have such large waves that they travel over almost anything smaller than a mountain.

The bad news is that one of the greatest influencers of sound propagation is the one over which humans have the least amount of control: the weather. Certain weather conditions can make sound travel for great distances, and others barely at all. Temperature and wind velocity are the prime variables in this phenomena, and the swing at one place between the most favorable and least favorable weather conditions can be as much as 40-50 dB (equating to a 16-32x increase in perceived loudness).

Since sound travels through air, a receiver downwind of the source will be subjected to higher sound levels than a receiver upwind; the breeze is actually helping move the sound to the downwind receiver, but upwind the sound must "swim against the current."

Combine wind direction with temperature variation (as a rule, sound usually travels further in cold temperatures) and one may observe the phenomena of *atmospheric refraction*. This is the process by which atmospheric conditions actually bend and/or focus sound waves toward some areas and away from others.

This makes predicting sound travel tricky, but the Explosives Research Group (ERG) and the University of Utah developed guidelines to help determine what would be "good" or "bad" firing times. These guidelines are summarized in Table 2-1.

"Good" Firing Conditions	"Bad" Firing Conditions
Clear skies with billowy cloud formations, especially during warm periods of the year. A rising barometer immediately following a storm.	Days of steady winds (5-10 mph) with gusts of greater velocities (above 20 mph) in the direction of nearby residences. Clear days on which "layering" of smoke or fog are observed. Cold, hazy, or foggy mornings. Days following a day when large extremes of temperature (about 36°F) between day and night are observed. Generally high barometer readings with low temperatures.

Table 2-1 University of Utah Criteria for "Good" and "Bad" Firing Conditions

2.3.2 NOISE METRICS

There are several metrics that may be used to measure sound to make it relevant to a situation. Certainly few people would complain if a plane flew over their house at 15,000 feet once a year at 2:00 in the afternoon. Yet, if that plane flew over a house at 500 feet once a day at 2:00 in the morning, it would be a different story entirely.

So, questions such as "what time?" and "how often?" are just as important as "how loud?" when it comes to making sound measurements meaningful for the purposes of complaint management. The following are the primary metrics that USAPHC and the Construction Engineering Research Laboratory (CERL) use for measuring military noise (please see Appendix A for more in-depth definitions):

- Equivalent-continuous Sound Level (L_{eq}) – Sound exposure "averaged" over a prescribed time period (usually 24 hours).

- Day-Night Average Level (DNL) – An average like the L_{eq} but with a 10dB "penalty" inflicted on sounds occurring between the hours of 2200 and 0700 (a particularly intrusive time when people are usually sleeping). As discussed above, the DNL may be A-weighted (ADNL) or C-weighted (CDNL) depending on the noise being measured. This average is calculated over a "year," or typically 250 (for active military) and 104 (National Guard) training days.

Note: Since they are based on averages, DNL noise contours (see next Section) grow larger the more shots are fired.

- Sound Exposure Level (SEL) – the total energy of a sound event normalized to a specific amount of time (e.g., one second) so that sounds of different durations may be compared directly.

- PK15(met) – the peak sound level, factoring in the statistical variations caused by weather, that is likely to be exceeded only 15% of the time (i.e., 85% certainty that sound will be within this range). This exists only in modeling—one cannot take a PK15(met) reading on the ground—and it is used for land use planning with small arms and as additional information for large arms and other impulsive sounds.

  Note: If there are multiple weapon types fired from a particular location (or multiple firing locations), the single event level used to create a noise contour (see next Section) is the loudest level that occurs at each receiver location. As such, PK15(met) contours are the same size no matter how many shots are fired.

- Unweighted Peak – the peak, single event sound level without weighting, on the ground. This measurement takes into account everything from berms, to weather, to the length of the grass—but it is only good for that moment in time under those exact conditions. Consequently, there is no particular confidence built in that the number is reliable in other situations, such as with the 85% certainty built into the PK15 (met) above.

There is no single perfect way to measure noise because different entities have different preferences for what is important. Still, combinations of the above metrics give the clearest picture of a noise environment currently available, and in them most people will find the information they need.

2.3.3 NOISE ZONES

When it comes to land use planning there needs to be a way to represent the above-mentioned metrics visually on a map. This will allow the user to readily see what areas are impacted and to what degree. This is accomplished by employing computer modeling programs to create *noise zones* that, using Geographic Information Systems (GIS), may be overlaid onto maps showing installations, airports, neighborhoods, and the like. Once this is done, it becomes readily apparent which areas in and around an installation are or could be (if improperly developed) exposed to unacceptable levels of noise.

2.3.3.1 NOISE ZONES AS THEY RELATE TO LAND USE

The Army uses a system whereby noise is partitioned into three noise zones, each labeled by Roman numerals and each representing an area of increasing noise. As particular uses such as schools, residences, and churches are more sensitive to noise than other more industrial uses, the zones help to create a picture of where things should be located. Please see Section 9 and Appendix E for more details regarding which uses should be permitted in each noise zone.

Noise Zone I (NZ I)

NZ I includes all areas in which the PK15(met) decibels are less than 87 dB (for small arms), the ADNL is less than 65 (for aircraft), or the CDNL is less than 62 (for large arms and explosions)—it's usually the furthest zone from the noise source, and it is basically all areas not in either of the next two zones. As a rule, this area is suitable for all types of land use.

Noise Zone II (NZII)

This is the next furthest area away from the noise source where the PK15(met) decibels are between 87 and 104, the ADNL is between 65 and 75, or the CDNL is between 62 and 70. The noise exposure here is considered significant and the use of land in this zone should generally be limited to activities such as manufacturing, warehousing, transportation, and resource protection. Residential use is strongly discouraged; however, if the community determines that this land must be used for houses, then the integration of NLR features into the design and construction should be required. Further details of NLR ideas and strategies are available from USAPHC.

Noise Zone III (NZ III)

NZ III is the area closest to the source of the noise where the PK15(met) decibels are greater than 104, the ADNL is greater than 75, or the CDNL is greater than 70. The noise level in this area is so severe that noise-sensitive uses are never recommended for these areas.

One final zone is the more informal *Land Use Planning Zone* (LUPZ). This zone is at the upper end of the NZ I and is defined by a CDNL of 57-62 or an ADNL of 60-65. It accounts for the fact that some installations have seasonal variability in their operations (or several unusually busy days during certain times of the year) and that averaging those busier days over the course of a year (as with the DNL) effectively dilutes their impact. Showing this extra zone creates one more added buffer layer to encroachment and it signals to planners that encroachment into this area is the beginning of where complaints may become an issue, and that extra care should be taken when approving plans. Table 2-2 shows all of the noise zones by the respective noise levels.

Noise Zone	Aviation (ADNL)	Small Arms (PK15(met))	Large Arms, Demolitions, Etc. (CDNL)
Land Use Planning Zone (LUPZ)	60-65	N/A	57 – 62
Zone I	<65	<87	<62
Zone II	65-75	87 – 104	62 – 70
Zone III	>75	>104	>70
Legend: > = greater than, < = less than, N/A = not applicable			

Table 2-2 Noise Zone Decibel Levels (AR 200-1)

Army Regulation 200-1 contains the specific regulations governing operational noise. As stated, the noise section of AR 200-1 may be found in Appendix F, and it is a must for any personnel responsible for the creation or mitigation of operational noise to familiarize themselves with this document.

2.3.3.2 THE ARMY COMPATIBLE USE BUFFER (ACUB) PROGRAM

Along with the aforementioned noise zones, the Army has a specific program designed to limit the effects of encroachment. The ACUB program was borne out of a 2002 expansion of the Private Lands Initiative (10 USC §2684a) and it allows military departments to partner with private organizations to establish buffer areas around active installations. These partnerships benefit the citizens of the United States in a number of ways:

- Military readiness is maintained when training days are not lost to encroachment issues.
- Open spaces are protected from development and many times may be used by the public for recreational purposes.
- The military need not buy and maintain more land in order to meet its training needs.
- Critical habitat for threatened and endangered species (TES) is preserved or created.

An example of the success that the ACUB program is capable of garnering can be found at Fort Carson, Colorado. Through good will and cooperation between Fort Carson, the Nature Conservancy and private land owners, Fort Carson was able to put into motion mechanisms to protect its entire southern boundary and a large portion of its eastern boundary from incompatible development, and thus protect the training at its southern ranges.

More information on the ACUB program and other issues of range sustainability can be found at:

http://www.sustainability.army.mil/

2.3.4 THE SPECIFICS OF MILITARY NOISE

The previous section briefly touched on military noise when it introduced the idea of A- and C-weighting for different types of sounds. But, military operations produce several different kinds of sounds that could be construed as noise under the right conditions, and understanding where the noise is coming from is critically important to mitigation efforts by both the installation and the community.

2.3.4.1 SMALL ARMS

The firing of small arms (that is, weapons less than 20 mm) is one of the most common sources of military noise. Given that small arms ranges take up relatively little space, and that all members of the military must qualify at least annually with their weapons, it is little surprise that nearly every installation has at least one small arms range.

The computer model used to create the noise contours for small arms ranges is the Small Arms Range Noise Assessment Model (SARNAM) Version 2.6, and it uses the peak noise level to create noise zones. SARNAM incorporates the latest available information on weapons noise source models, directivity, sound propagation, and the effects of noise mitigation and safety structures such as berms, wall, and ricochet barriers.

For reference, Table 2-3 shows the *unweighted* peak levels (i.e., no filters, and not taking into account any mitigation or safety structures) for an M-16 rifle so that the reader may get a feel for the directivity and distance decay of small arms noise. Note: the 180° azimuth is directly behind the weapon.

Distance (meters)	**Predicted Level, dBP** Azimuth		
	0°	**90°**	**180°**
50	135-150	112-127	102-117
100	113-128	106-121	95-110
200	106-121	99-114	89-104
400	93-108	86-101	78-93
800	85-100	77-92	69-84
1600	75-90	67-82	59-74

Table 2-3 Predicted Unweighted Peak Decibels (dBP) for an M-16 (5.56 mm) Rifle

This table is useful in conveying two pieces of information: First, when dealing with small arms ranges, the direction of fire has a large impact on noise levels. Secondly, the impact of a small arms range is relatively localized and thus, under most weather conditions, once a receiver is 1,000 meters from the range, levels should not be high enough to annoy people.

2.3.4.2 LARGE ARMS AND DEMOLITIONS

The sounds from large arms (>20mm) and demolitions create the largest complaint issues because the sound can travel so far, it is so difficult to stop, and it can be accompanied by vibration that may increase the public's annoyance.

This type of noise is modeled using the BNOISE2 (Version 1.3) computer modeling program and contours are shown on maps in both the average (C-weighted DNL) and PK15(met) iterations. AR 200-1 states that the CDNL should be used for the purposes of land use planning (Table 2-2). However, members of the public often view "averages" incredulously, so the PK15(met) contours are shown to give an idea with 85% certainty of how loud at any particular location single events are likely to get.

The unweighted peak threshold of physiological hearing damage to the human ear is approximately 140 dBP, but the threshold for annoyance varies greatly among individuals. So, based on the experiences of the Naval Surface Warfare Center (Dalhgren, VA), USAPHC uses the set of guidelines shown in Table 2-4.

Predicted Sound Level (dBP)	**Risk of Complaints**
<115	Low risk of complaints
115-130	Moderate risk of complaints
>130	High risk of noise complaints.
Note: For rapid fire test programs and/or programs that involve many repetitions of impulse noise, reduce allowed sound levels by 15 dBP.	

Table 2-4 Complaint Risk Guidelines

Pairing these guidelines with the following tables (Tables 2-5 and 2-6) give an example of what noise levels to expect at specific distances, and whether or not those levels have a risk of generating complaints. Again, an azimuth of 180° means that the listener is behind the gun.

Distance (meters)	**Predicted Level (dBP)** **Azimuth**		
	0°	90°	180°
500	138-148	137-147	133-143
1,000	127-137	126-136	122-132
2,000	115-127	114-126	110-122
3,000	108-121	107-121	103-116
4,000	103-117	103-116	98-112
5,000	100-114	99-113	94-109

Table 2-5 Predicted Peak Sound Levels for 120 mm Tank Gun Firing

Distance (meters)	**Predicted Level (dBP)** **Azimuth**		
	0°	90°	180°
500	136-146	131-141	122-132
1,000	125-135	120-130	111-121
2,000	113-125	108-120	99-111
3,000	106-119	101-114	92-105
4,000	101-115	96-110	87-101
5,000	97-112	92-107	83-98

Table 2-6 Predicted Peak Sound Levels for 155 mm Howitzer Firing

Regarding vibration, studies (Siskind, 1989) have shown that homeowners become concerned about the structural rattling and potential damage when the peak decibels exceed 120 dBP, but actual damage isn't likely to occur at decibels lower than 150 dBP.

2.3.4.3 AIRCRAFT

Aircraft noise is also very common at military installations now that the use of helicopters has become so important in modern warfare, and given the fact that even the smallest installations can employ them (since they do not need space for a runway). So, between classic propeller, jet, and rotary aircraft, the possibilities for aircraft noise complaints are growing.

Several computer models are used to visualize aircraft noise but the most common is NOISEMAP/BASEOPS. Table 2-2 spells out the AR 200-1 ADNL aircraft noise zones used for land use planning.

But, as stated before, the ADNL is just an average; maximum levels are often a good predictor of complaint potential. Thus, the tables below give the expected maximum levels for the most common types of military aircraft (Table 2-7), and the percentage of the population that is likely to be annoyed by particular maximum levels (Table 2-8). It should be noted that the annoyance levels presented in Table 2-8 were determined based on a study where respondents were exposed to over 50 over flights per day. While annoyance levels will probably be lower in areas with fewer operations, using these two tables can give a rough idea of whether a complaint may be received given specific training parameters.

Slant Distance (Feet)	**Maximum Sound Level by Aircraft Type (dBA)**						
	C-130H	C-17	AH-64	CH-47D	OH-58D	UH-60A	F-16
200	100	108	92	98	89	91	119
500	92	98	84	89	81	83	110
1,000	85	89	77	83	74	76	102
2,000	77	80	70	77	67	69	95
5,000	66	66	60	67	56	58	83
10,000	57	57	50	59	47	48	73

Table 2-7 Maximum A-Weighted Sound Levels of Common Military Aircraft

Maximum Level (dBA)	**Percentage Highly Annoyed**
70	5 %
75	13 %
80	20 %
85	28 %
90	35 %

Table 2-8 Percentage of the Population Likely to be Highly Annoyed by Particular Levels of Aircraft Noise (Rylander 1974)

2.3.4.4 MANEUVER TRAINING AND OTHER TRANSPORTATION

At most installations, noise from maneuver training isn't a problem because the noise from vehicles doesn't travel beyond the distance away from the public that is needed to maintain security. Occasionally convoys or special circumstances can be disruptive, but usually not to the point where it would cause a complaint about noise.

Additionally, maneuver training rarely creates enough noise to create a noise zone contour that can be shown on a map so nearly any adjacent land use is technically compatible (though not always desirable).

2.3.4.5 MISCELLANEOUS

Other sources of military noise include generators, production facilities, research and development facilities, and repair operations. For the most part, complaints from these types of sources are rare and are often resolved at an installation-level.

As with maneuver training, these types of noise producers also rarely create enough noise to create a noise zone contour.

2.4 OPERATIONAL NOISE MANAGEMENT AND MITIGATION

The fact that military training makes noise will not change for the foreseeable future. But, it is possible for both the military and civilian communities to work together for mutual benefit to change how noise is handled.

As has been said previously, noise management on the community's side of the fence is best accomplished through an intelligent, common-sense approach to land use planning next to the installation, entailing a willingness to be creative with how to use the land to accommodate the community's growth needs.

On the military side of the fence, successful operational noise management is generally tackled on two fronts: physical mitigation measures and procedural changes.

2.4.1 PHYSICAL NOISE MITIGATION

Physical mitigation is the idea of putting something in between the source and the receiver, or otherwise orienting the source so that noise is directed away from the receiver to the greatest extent possible. Physical mitigation is best planned for before construction, but it may also be employed after construction in some situations. Examples of physical mitigation are:

- Locating/re-locating ranges relative to natural impediments such as in valleys or behind large stands of trees.

- Constructing artificial berms or enclosing a small arms range within walls and baffles.

- Orienting noise sources toward the interior of the installation property.

As alluded to in the section on propagation (Section 2.3.1.1), the physical mitigation of noise is generally feasible only on the higher frequency sounds such as small arms fire, because the low frequency component of impulsive noise has wave characteristics that make ineffective all but the largest obstacles.

2.4.2 PROCEDURAL NOISE MITIGATION

Physical mitigation of noise (where feasible) should also be coupled with procedural changes that lessen either the noise itself, or the likelihood that the noise will impact the community.

Procedural mitigation includes such steps as:

- Implementing fly-neighborly programs that adjust aircraft training times and routes to lower the impact on the community to the greatest extent possible given mission requirements.

- Adjusting the timing, where feasible, of particularly disruptive activities to avoid conflicts with local events such as church times or holidays.

- Keeping the community informed (when feasible), making public any unusual increases in the intensity of training or if training is to be resumed after a period of inactivity.

- Proper review of Environmental Assessments (EAs) and Environmental Impact Statements (EISs) to ensure that the noise impacts of the proposed actions are addressed and are consistent with the current SONMP.

- Physical monitoring of the noise environment (as opposed to computer modeling) when the noise environment is controversial, when an NZ III exists in a noise-sensitive area, and when a noise is unique and cannot be modeled.

- Incorporating noise contours as a layer on the facilities GIS so that the contours may be combined with other layers (such as land use) and referenced when siting new facilities.

Obviously, efforts at reducing noise impacts through procedural means can only be effective if they are adhered to. As such, the proper training of personnel to consistently follow noise mitigation procedures that are in place is vitally important.

2.5 NOISE COMPLAINT MANAGEMENT

In accordance with Army Regulation (AR) 200-1 the U.S. Army Hawai`i (USARHAW) has implemented a noise complaint management program. The Public Affairs Office (PAO) has been proactive addressing noise complaints and local public concerns which include monthly board

meetings in the following areas: Waianae, Ko'olauloa, Wahiawa, Mililani Mauka / Lanunani Valley, North Shore, Mililani / Waipio / Melemanu and Nankuli. Figure 2-1 on the next page includes a copy of the U.S. Army, Hawai`i Noise Abatement Form.

The phone number for noise related complaints is # 808-656-3159. This number is for the Public Affairs Office, Community Relations for the U.S. Army Garrison- Hawai`i. Calls received are handled without delay and the complainant is informed of the USARHAW mission and that every effort will be made to correct the problem, mission permitting.

Noise Abatement Report Form

PART I: TO BE FILLED OUT BY REQUESTOR	Date of Request:
To: **Public Affairs Office** **Attn: Community Relations Officer** **Fax: 656-3162** **Phone: 656-3159**	From: (Name and Organization) Phone: Fax: E-mail:
Date of incident: Time of incident:	If incident involved aircraft, was it: ☐ Fixed Wing ☐ Rotary (helicopter)
Location:	
Briefly describe the incident:	
Action Officer/POC:	
Action Taken:	
Recommendation:	
Requestor's Signature:	Date:

PART II - FOR USE OF USAG-Hawaii			
Office	Name/Title	Date	Concur/Nonconcur
G3 Training			
AVN BDE			
Range Cont.			
CG			

Activity reported was:		
☐	AUTHORIZED	Unit conducting training:
☐	UNAUTHORIZED	Branch: ☐ Army ☐ Air Force ☐ Marines ☐ Navy
Response to Community:		

Figure 2-1 U.S. Army Hawai`i Noise Abatement Form

2.6 SUMMARY

This section provided the scientific basics of sound itself, the reasons that a sound may become noise, the sources of operational noise, the basics of mitigation, the correct noise complaint management procedures and the big picture of how all of these relate to encroachment and complaints.

Operational noise and development pressures will continue to create the possibility of friction for the foreseeable future. However, sensible planning and the appropriate, timely management of problems can prevent localized pockets of discontent from destroying a mutually beneficial relationship between an installation and its surrounding community.

The following sections will provide address in detail the specific noise environments at relevant areas.

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3.0
U.S. ARMY HAWAI`I AND THE COMMUNITY

3.1 LOCATION

The U.S. Army Hawai`i (USARHAW) has 7 major training areas and 2 Army Airfields under its command listed below. The Statewide Operational Noise Management Plan (SONMP) will detail each training site in the following chapters:

Island of O`ahu:

- Schofield Barracks
- Schofield Barracks East Range
- Kahuku Training Area
- Kawailoa Training Area
- Makua Military Reservation
- Wheeler Army Airfield
- Dillingham Military Reservation [2]

Island of Hawai`i (Big Island):

- Pohakuloa Training Area
- Bradshaw Army Airfield

Figure 3-1 shows the State of Hawai`i vicinity and generalized locations for U.S. Army training areas and airfields on the islands of O`ahu and Hawai`i. (Specific training area and airfield locations are detailed in the following chapters.) This chapter will focus on the overall mission, history, and background of the USARHAW.

3.2 HISTORY [3]

3.2.1 SCHOFIELD BARRACKS

In 1908, a temporary Army post was constructed in the uplands between Waianae and Koolau mountain ranges. This facility, originally known as Castner Village or Leilehua Barracks, and later renamed Schofield Barracks, served as the headquarters of the United States Army District of Hawai`i. Schofield Barracks was named in honor of LTG John M. Schofield, who, in 1872 recognized the strategic importance of O`ahu to the defense of the United States.[4] Construction began on the barracks in 1909.

[2] Dillingham Military Reservation has leased Dillingham Airfield to the Hawai'i Department of Transportation
[3] Schofield Barracks Military Reservation Real Property Master Plan
[4] http://www.globalsecurity.org/military/facility/schofield-barracks.htm

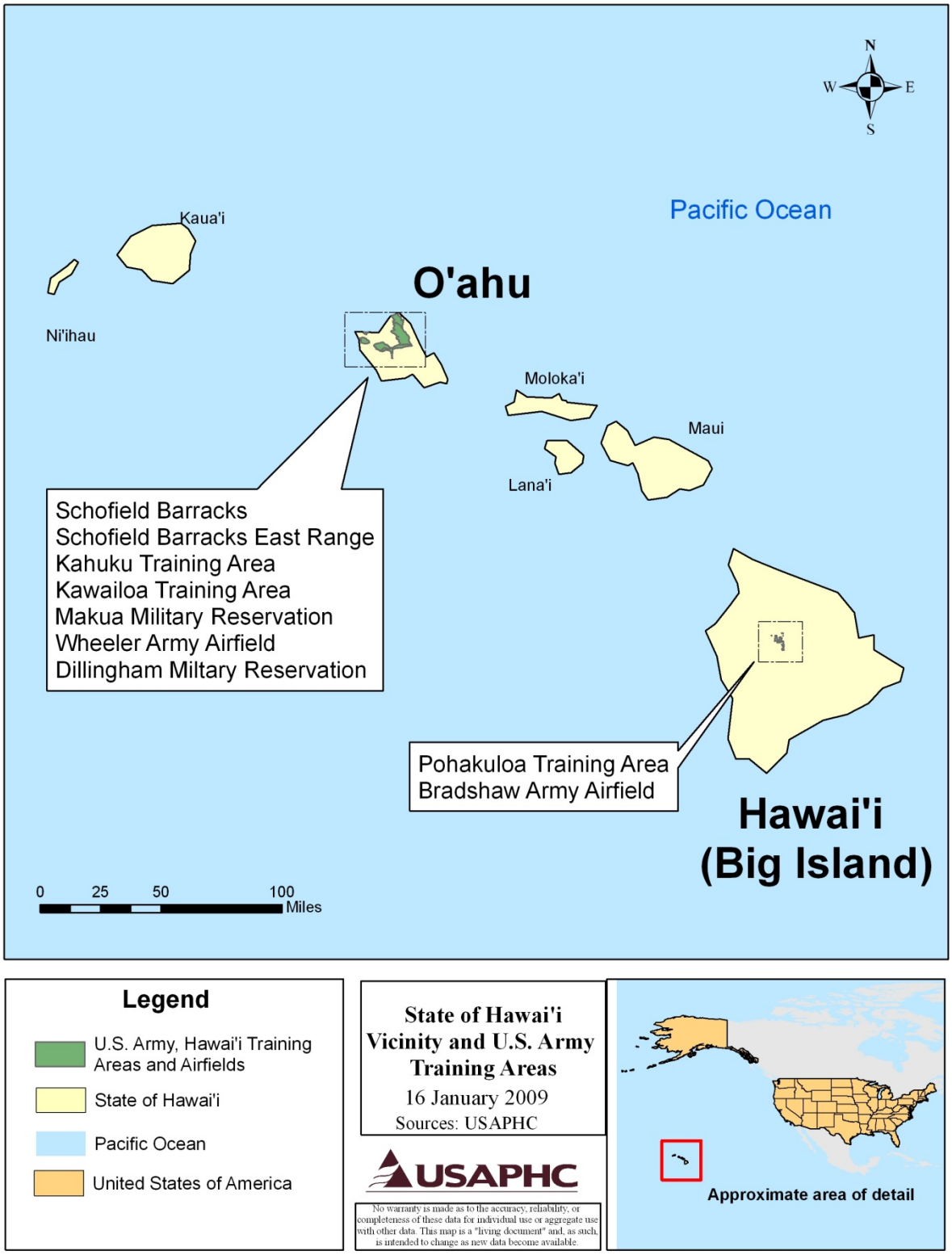

Figure 3-1 State of Hawai`i Vicinity and U.S. Army Training Areas and Airfields

During the years before World War I, there was a major build-up of Schofield Barracks and the other Army facilities on O`ahu.

The attack on Pearl Harbor caught the residents of O`ahu off guard, including the troops stationed at Schofield. Wheeler Field was one of the first flight lines attacked and suffered extensive damage and heavy casualties compared to Schofield Barracks. The island of O`ahu was turned into a military base and martial law was declared to minimize the perceived threat of sabotage.

After peace was declared in 1945, troops temporarily assigned to Schofield Barracks returned home. The return of the 25th and 24th Infantry Divisions to Schofield was delayed as they were part of the occupying army in Japan and were subsequently ordered to serve in Korea.

During the Korean War, Schofield Barracks was used as a basic training center to train replacement troops for Korea.

The 25th Infantry Division was finally ordered back to Schofield Barracks in 1954. The 15,000 troops brought new economic life to the surrounding areas and caused Hawai`i's population to increase by five percent. The period between the Korean War and Vietnam included many command structure changes in Hawai`i. Army activities relating to Hawai`i, formally coordinated by the U.S. Army Pacific (USARPAC) at Fort Shafter, were assigned to the U.S. Army Hawai`i / 25th Infantry Division. In 1960, the single command concept was abandoned and the USARHAW became the U.S. Army Support Command, Hawai`i (USASCH), with its headquarters at Fort Shafter.

Although military forces had been present as advisors in Vietnam since 1954, intensive troop buildup occurred over time. The 25th Division became heavily engaged in combat from 1965 through 1969.

In 1983, the Chief of Staff of the Army directed the development of a light division comprised of approximately 10,000 soldiers. This division was configured to require minimal support and be rapidly deployed. The conversion of the 25th Infantry Division to a light configuration was a result of this mandate and was completed in the fall of 1986.

3.2.2 WHEELER ARMY AIRFIELD

Wheeler Army Airfield was established on a tract of land originally set aside by Presidential Executive Order dated July 20, 1899 to establish Schofield Barracks. On March 1, 1921, the Army's force structure on the island of O`ahu was organized as the Hawai`ian Division. Wheeler Field was one of four areas at Schofield Barracks that supported the new division.

Wheeler Field was the site of many historical aviation events. In June 1927, two Army pilots made the first flight from the mainland to Wheeler Field in a Fokker tri-motor in 25 hours and 50 minutes. The Great Dole Derby was also conducted in 1927 and $25,000 was awarded to the first civilian to fly from Oakland to Wheeler. The first transpacific flight from California to Bisbane, Australia, was accomplished by two Australian military aviators whose first leg ended

in a landing at Wheeler. In 1935, Amelia Earhart accomplished the first solo flight from Wheeler to Oakland in a flight time of 18 hours and 16 minutes. Her flight marked the first use of radio and telephone communication with the shore.

Wheeler Field was a primary target during the Japanese surprise attack on Sunday, December 7, 1941. Planes were lined up close together as a precaution against saboteurs, and as a result became easy targets for the attacking aircraft. Within two hours all but 27 of the 153 aircraft at Wheeler were destroyed or damaged. Personnel casualties included 37 killed, 6 missing, and 53 wounded. Severe damage was evident throughout the flight line and hanger areas. Wheeler Airfield and Schofield then became training facilities for organizations deploying throughout the Pacific.

The National Security Act of 1947 created the United States Air Force from the Army Air Corps. On 15 April 1948, Wheeler Field was redesignated as Wheeler Air Force Base. The installation became inactive in 1949. The end of World War II did not mark the return of either the 24th nor 25th Infantry Divisions to Schofield Barracks. Both remained as part of the Army of Occupation in Japan. The 25th Infantry Division was not to return to O`ahu until 1954 after four years of combat in Korea. A small Army aviation contingency was based at Wheeler Air Force Base to support the 25$^{th}$ Infantry Division. The airfield facilities were shared by the Army, Air Force, Navy and Hawai`i Air National Guard. In the late 1960s, the 25th Infantry Division deployed for Vietnam. By 1977 after its return from Vietnam, the army aviation expanded to become the dominant aviation activity and user of Wheeler's airfield administration, maintenance, and operations. Wheeler Field was placed in nomination as a national Historical Landmark on 9 April 1987, and officially approved as such by the Department of Interior on 28 May 1987.

Throughout the 1980s the USAF and U.S. Army negotiated for an exchange of Wheeler Air Force Base for Fort Kamehameha Military Reservation, Hawai`i. A Memorandium of Understanding was executed by the Commander in Chief, Pacific Air Forces and the Commander, United States Army Western Command on 27 July 1989. Supplemental negotiation and agreements continued to fine-tune the exchange. Eventually, Wheeler Air Force Base was formally redesignated as Wheeler Army Airfield (WAAF) on November 1, 1991. Its primary function remains the support of the Aviation Brigade within the 25th Infantry Division (Light). The Directorate of Public Works, United States Army Garrison-Hawai`i has its principal offices at Wheeler Army Airfield, and functions as the host to a variety of Department of Defense and Hawai`i Air and Army National Guard organizations.

Over the years some of the ceded land was returned to the State of Hawai`i to support construction of Kunia Road, about 136.77 acres were transferred to the Department of the Army (DA) as an addition to the Waikakalaua Ammunition Storage Site, and 34.61 acres were transferred to the Department of the Navy to become the Camp Stover family housing area. Today Wheeler Army Airfield is comprised of 1,388.92 acres of ceded (set aside for military purposes), 20.26 acres of use permit and .60 acres of easement.

3.2.3 POHAKULOA TRAINING AREA

Pohakuloa Training Area (PTA) was formerly known as Saddle Training Area and was first proposed for expansion as the PTA in 1954. Early in 1942, the U.S. Army decided that a cross-island road was imperative to the defense of Hawai`i. Approval was granted for a road, extending from Kaumana, a little village located at the end of Waianuenue Avenue extension of Hilo Town, across the lava flows to the Humuula Sheep Station where it joined the existing trail from the Waimea area. Kaumana Road, now called Saddle Road, was opened in September 1942. The built-up cantonment, consisting of approximately 144 net acres, is situated along the Saddle Road.

3.3 MISSION, TRAINING AND ORGANIZATION

3.3.1 MISSION

The mission of the USARHAW is to provide the administrative, operational, maintenance, housing, training, and community support required by the 25th Infantry Division, the U.S. Army Garrison, other tenants of the installations, and their dependents. Table 3-1 lists the total Army population in Hawai`i to total over 63,000 as of FY2005.

In Hawai`i, training occurs year around. Even though most of this training is done in remote areas, it does generate noise that may impact upon the citizens who live in the surrounding communities or who use the adjacent areas for recreation. The goal in the establishment of the SONMP is to achieve a harmonious relationship between the soldiers who train at these facilities and those who live, work or recreate in the adjacent areas.

Active	17,314
Civilians	4,094
NAF	1,544
Contractors	2,424
Tenants (100)	9,960
Family Members	32,433
Retirees	4,923
Retirees (FMs)	12,335
Others off base	3,569
Total	**88,596**

Table 3-1 Army Population Supported in Hawai`i March 2006 [5]

3.3.2 TRAINING

The USARHAW provides facilities for a variety of units to perform live-fire exercises, and evaluate the maneuvering capability and training, and helicopter gunnery, small arms, mortar, and artillery firing and exercises. This training is performed at a large portion of the PTA. Also,

[5] http://www.garrison.hawaii.army.mil/sites/about/facts.asp

Schofield Barracks provides training grounds for the 25th Infantry Division and other Army and Marine Corps units, and Wheeler and Bradshaw Army Airfields provide support for the assigned and visiting aviation units training at the neighboring training areas. Site specific training will be detailed in the following chapters.

3.3.3 ORGANIZATION [6] [7]

The 25th Infantry Division ("Tropic Lightning") is the primary command of USARHAW consisting of a rapid strike force of nearly 17,000 soldiers. In January, 2006 the 25th Infantry Division (light) was redesignated as the 25th Infantry Division. The "light" segment of the name was dropped to reflect the changes the force underwent during the Stryker and modular force transformations. The 25th Infantry division is composed of Stryker, light infantry, airborne and aviation. The figure on the next page is the current command structure of the 25th Infantry Division.

[6] http://www.globalsecurity.org/military/agency/army/25id.htm
[7] http://www.globalsecurity.org/military/agency/army/usaghi.htm

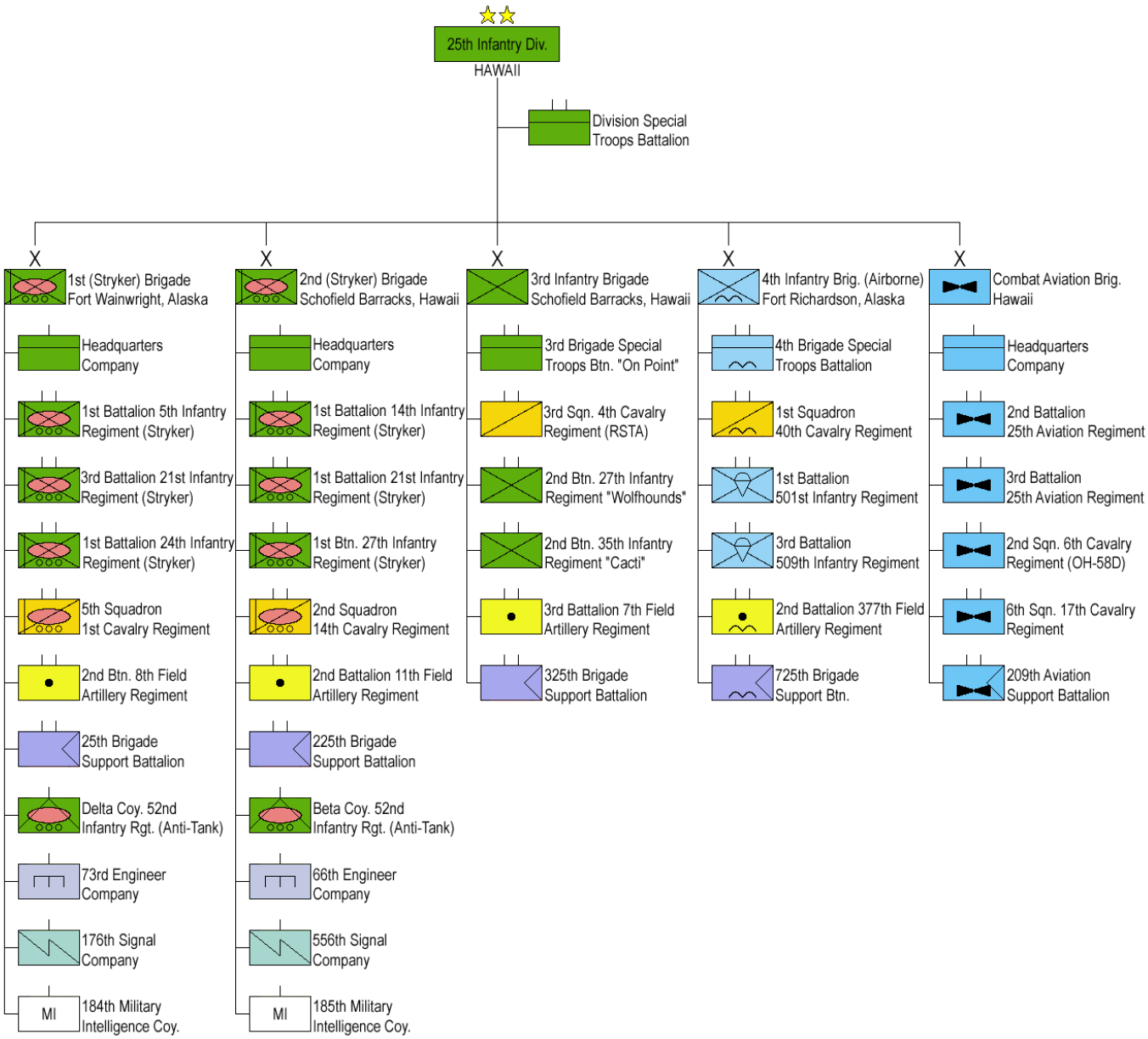

Figure 3-2 25th Infantry Division Command Structure [8]

The U.S. Army Garrison-Hawai`i, (USAG-HI) consists of the Fort Shafter, Schofield Barracks, and PTA communities. Although these communities are geographically separate, the Garrison is organized, staffed, and operated under the single post concept. USAG-HI provides quality base operations support and services nearly 70,000 personnel dispersed throughout the Hawai`ian Islands, Johnston Island, Guam, Saipan, the Kwajalein Atoll, and American Samoa.

The USAG-HI provides quality facilities, services, and logistics functions to enhance combat readiness while maintaining an acceptable quality of life for soldiers and families. The USAG-HI

[8] http://en.wikipedia.org/wiki/25th_Infantry_Division_(United_States)

serves over 17,000 active duty Army soldiers. Primary services include, but not limited to test, administration, counseling support, computer support and facilities support.

3.4 ECONOMIC IMPACT

The USARHAW provides a significant economic impact to the community and businesses throughout the state. Table 3-2 shows the FY2005 economic impact of the U.S. Army to be nearly $1.9 billion dollars for the state of Hawai`i.

Active Duty Payroll	$643.8
National Guard Payroll	$33.7
Reserve Payroll	$8.0
Civilian Payroll	$282.9
Contracts	$346.0
Supplies, equipment, services	$489.2
Non-appropriated funds	$93.1
TOTAL	**$1,896.8**

Table 3-2 U.S. Army Economic Impact in Hawai`i FY2005 (Dollar figures listed in millions) [9]

3.5 LABOR FORCE, EMPLOYMENT AND INCOME[10]

Hawai`i's economy continued to slow through the first quarter of 2009, primarily the result of worsening national economic conditions and the decline of visitor industry activity in the state. Wage and salary jobs in the first quarter decreased from the year before, as gains in government jobs were more than offset by job losses in the private sector. Only Health Care and Social Assistance, and Educational Services among the private sector industries showed positive job growth in the first quarter of 2009. Total civilian employment also decreased significantly. Combined with a small decrease in the civilian labor force, the number of unemployed and the unemployment rate jumped from the same quarter in 2008. Visitor arrivals, visitor expenditures, new private building authorizations, government contracts awarded, and total tax collections distributed to the State general fund revenues all declined for the quarter.

The civilian labor force in Hawai`i decreased in the first quarter of 2009 to 647,000, a decrease of 4,050 people or 0.6 percent from the first quarter of 2008. However, the civilian employment decreased 27,450 people or 4.3 percent from the same quarter in 2008. As a result, the average number of civilian unemployed for the quarter jumped to 42,050, 125.5 percent higher than the year before. This pushed the unemployment rate up to 6.5 percent in the first quarter of 2009, compared with 2.9 percent a year earlier. In 2008, the unemployment rate averaged 3.9 percent, 1.3 percentage points higher than that of 2007.

[9] http://www.usarpac.army.mil/about/hawaii_economic2.asp
[10] http://hawaii.gov/dbedt/info/economic/data_reports/qser/state-economy

As of May 2009 the statewide unemployment rate in Hawai`i was 7.4%. This is currently two percent lower than the National unemployment rate of 9.4% as of May 2009 (Figure 3-3).

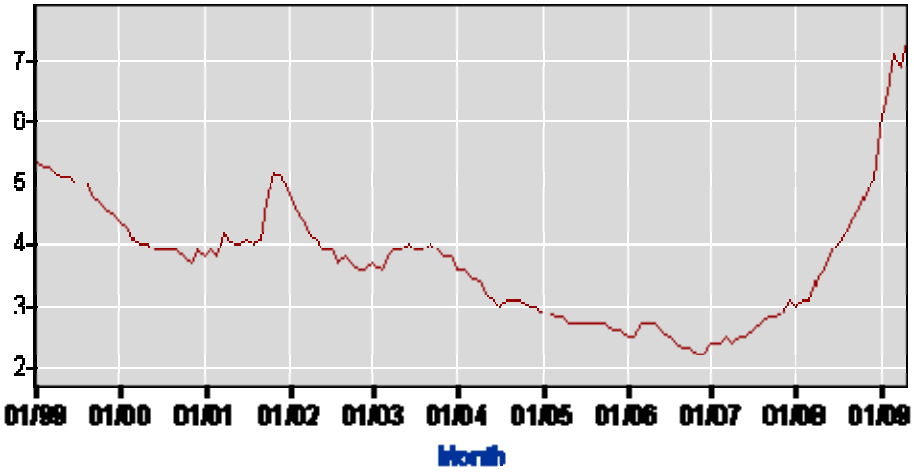

Figure 3-3 Hawai`i Unemployment Rate January 1999 to May 2009 [11]

The average weekly wage in Honolulu County was $800 in the first quarter of 2008, 3.6 percent higher than a year earlier, according to the U.S. Department of Labor's Bureau of Labor Statistics. Honolulu County ranked 89th in terms of wage growth and 169th in terms of wage level among the 334 largest counties nationwide with 75,000 or more jobs as measured by 2007 annual average employment. [12]

[11] http://www.bls.gov/ro9/qcewhi.htm
[12] http://www.bls.gov/ro9/qcewhi.htm

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4.0
SCHOFIELD BARRACKS MILITARY RESERVATION

4.1 GENERAL [13] [14]

Schofield Barracks Military Reservation (SBMR) is the largest Army post in Hawai`i, located on a 17,725 acre site in central O`ahu in the City and County of Honolulu in the Wahiawa District. The post lies adjacent to the town of Wahiawa, separated by Lake Wilson (also known as Wahiawa Reservoir) and is also near Mililani Town to the southeast (see Figure 4-1). SBMR extends from Kamehameha Highway; to the Waianae Mountain Range due West. The land uses at SBMR include the cantonment, maneuver training, firing ranges, impact areas and other areas unsuitable for maneuver.

The Main Post area consists of numerous Quadrangle-style barracks and unit command structures, most of which have a letter designation. B and C Quads are the oldest having been constructed in the 1920s, with D, E, and F quads being built later. Additionally on main post are the PX (post exchange), the Commissary, the "Aloha Building", the Library, Bowling Alley, and Uniform Clothing Store. Troop housing, operational facilities, family housing, warehouses, training facilities, and community services and facilities are located in the cantonment on about 6.5 square kilometers (1,605 acres).

Much of the housing on-post has been renovated or rebuilt now that the housing has been privatized. The Enlisted housing area lies to the west of Main Post, while the Officers housing lies to the north along Wilikina Dr.

[13] http://www.globalsecurity.org/military/facility/schofield-barracks.htm
[14] http://en.wikipedia.org/wiki/Schofield_Barracks

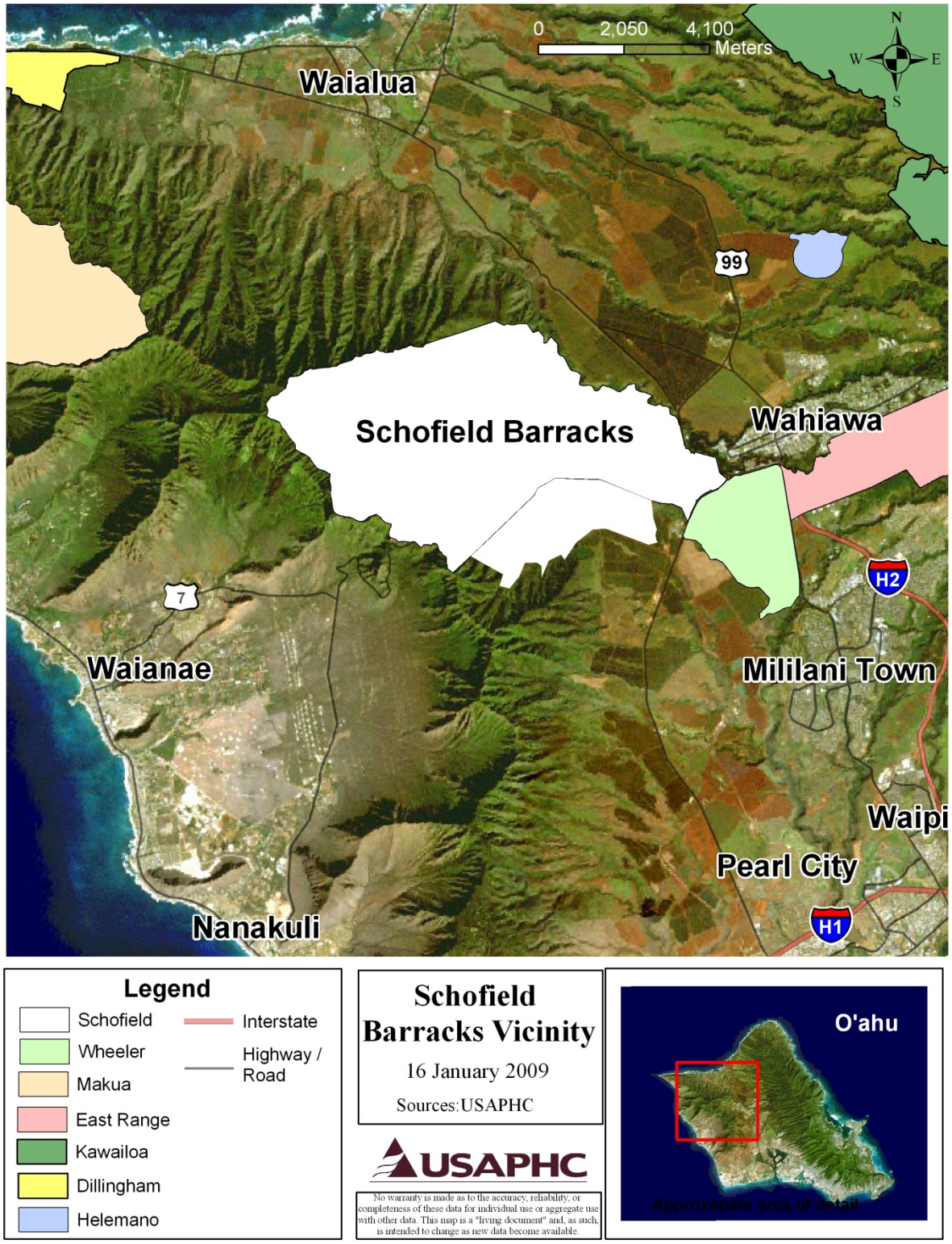

Figure 4-1 Schofield Barracks Military Reservation Vicinity

4.2 SURROUNDING LAND USES [15]

Many business establishments and hotels have developed the land surrounding SBMR to the east near the town of Wahiawa. The fertile land has also proven to be a means of resource for residents near the Army base. Pineapple and other Hawai`ian crop plantations grown near the installation are sold at local food shops and markets. Also, the local trade industry is seeing prosperity in the presence of historical site and tourism has kept at pace with developments on post.

Figure 4-2 indicates the majority of the land use surrounding SBMR as designated agricultural, preservation, and federal (Wheeler AFB, Schofield Barracks East Range, and Lualualei Naval Reservation). The closest residential area is Wahiawa, located less than ¼ mile due east from the Schofield boundary.

[15] http://www.hawaiistateinfo.com/schofield-barracks.php

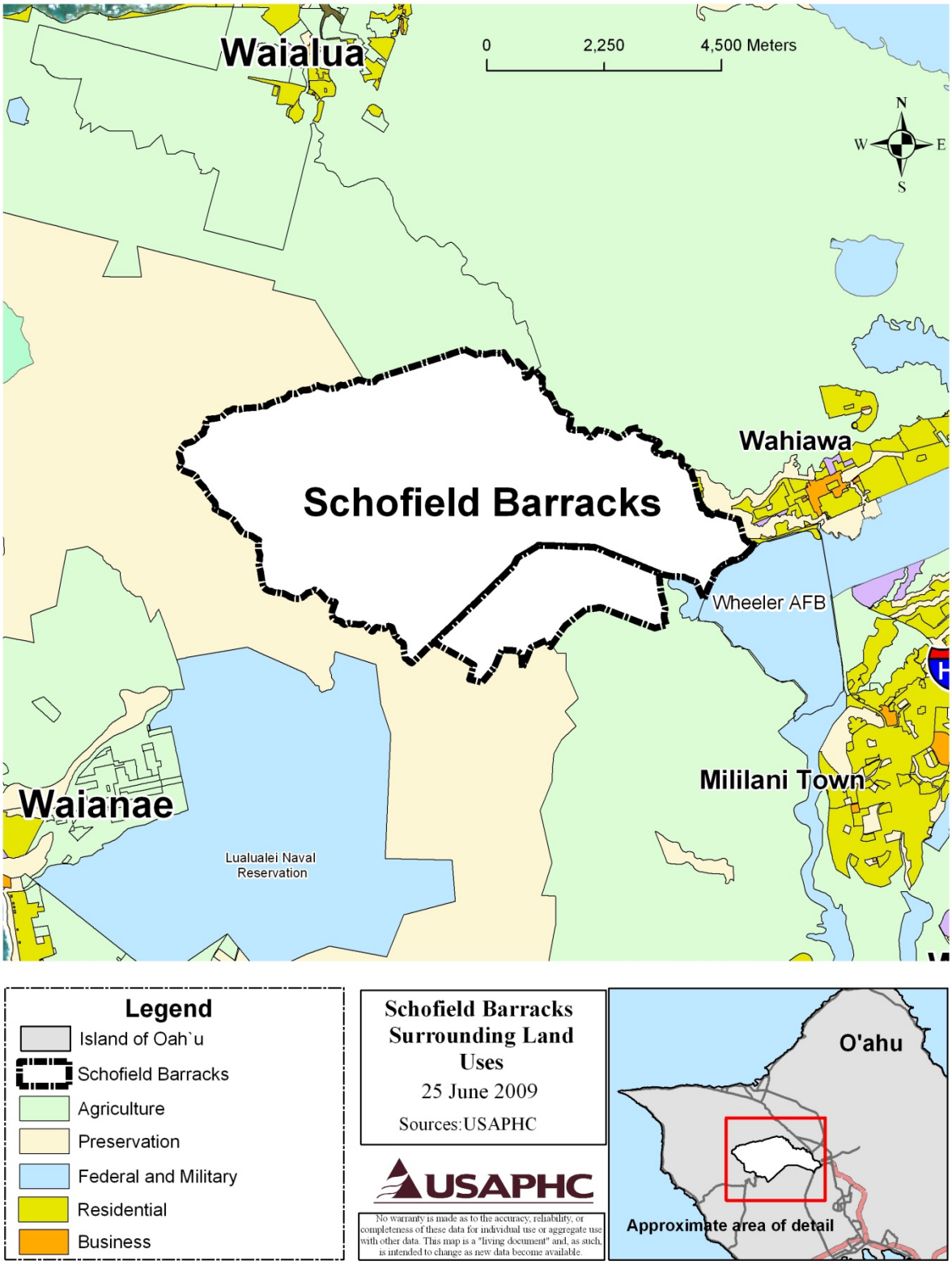

Figure 4-2 Schofield Barracks Military Reservation Surrounding Land Use

4.3 TRAINING [16]

SBMR has been the home of the 25th Infantry Division, known as the Tropic Lightning Division, since 1941 as well as the Command Headquarters for United States Army Hawai`i (USARHAW). SBMR is also home to the 8th Theater Sustainment Command.

Training and live fire impact areas are situated on steeply sloped land west of the cantonment area (see Figure 4-3) and are bordered to the north by the Mokuleia Forest Reserve and to the south and west by the Waianae Range ridge. The eastern sloping plateau of the Waianae mountain range is wooded and is used for tactical maneuver instruction, where soldiers use forest vegetation for concealment while training in navigation and infantry maneuvers.

The SBMR range complexes and the artillery firing is oriented so munitions are fired toward the impact area of about 11.24 square kilometers (2,780 acres) within the western portion of the reservation. The impact area supports the primary practice ranges on the island O`ahu. The firing ranges are used for small arms, machine gun, mortar, grenade, antitank, and limited short-range indirect fire artillery training. The master plan designates 1,235 acres as able to support maneuver training (South Range) and an additional 1,506 acres to support ranges and indirect fire activity.

Large open areas allow for air assault operations to take off and land. Covered concrete pads can provide shelter for units training in the area who do not wish to deal with sleeping in the field. The range control as well as numerous semi-automated and other firing ranges occupies this area as well.

The Schofield Training Area is not restricted by use agreement and exercises can be conducted seven days a week. The major constraint is in the insufficient size of the complex. Ideally, the impact area should be considerably larger with the ranges spread much further apart. The maximum firing distance is approximately five kilometers which is well below the maximum range of most artillery weapons. Because of the lack of maneuver space, the artillery pieces are positioned in a few firing points repeatedly. Additionally, the range and firing position safety zones overlap to such an extent that many ranges cannot be used simultaneously.

Recently, in October 2010, the 25th Infantry Division Combat Aviation Brigade officially returned home from a 12-month deployment to Iraq in support of Operation Iraqi Freedom. In late June 2010 the 2nd Stryker Brigade Combat Team, 25th Infantry Division deployed to Iraq for a 12 month deployment. Approximately 3,800 Soldiers from the brigade were deployed as an Advise and Assist Brigade in support of Operation New Dawn in Northern Iraq. They are at the forefront of training and empowering the Iraqi Security Forces. In addition, by fiscal year 2013, an expected increase of 778 soldiers will be added to SBMR as a result of the Army's "Grow the Army" (GTA) program.

[16] http://www.globalsecurity.org/military/facility/schofield-barracks.htm

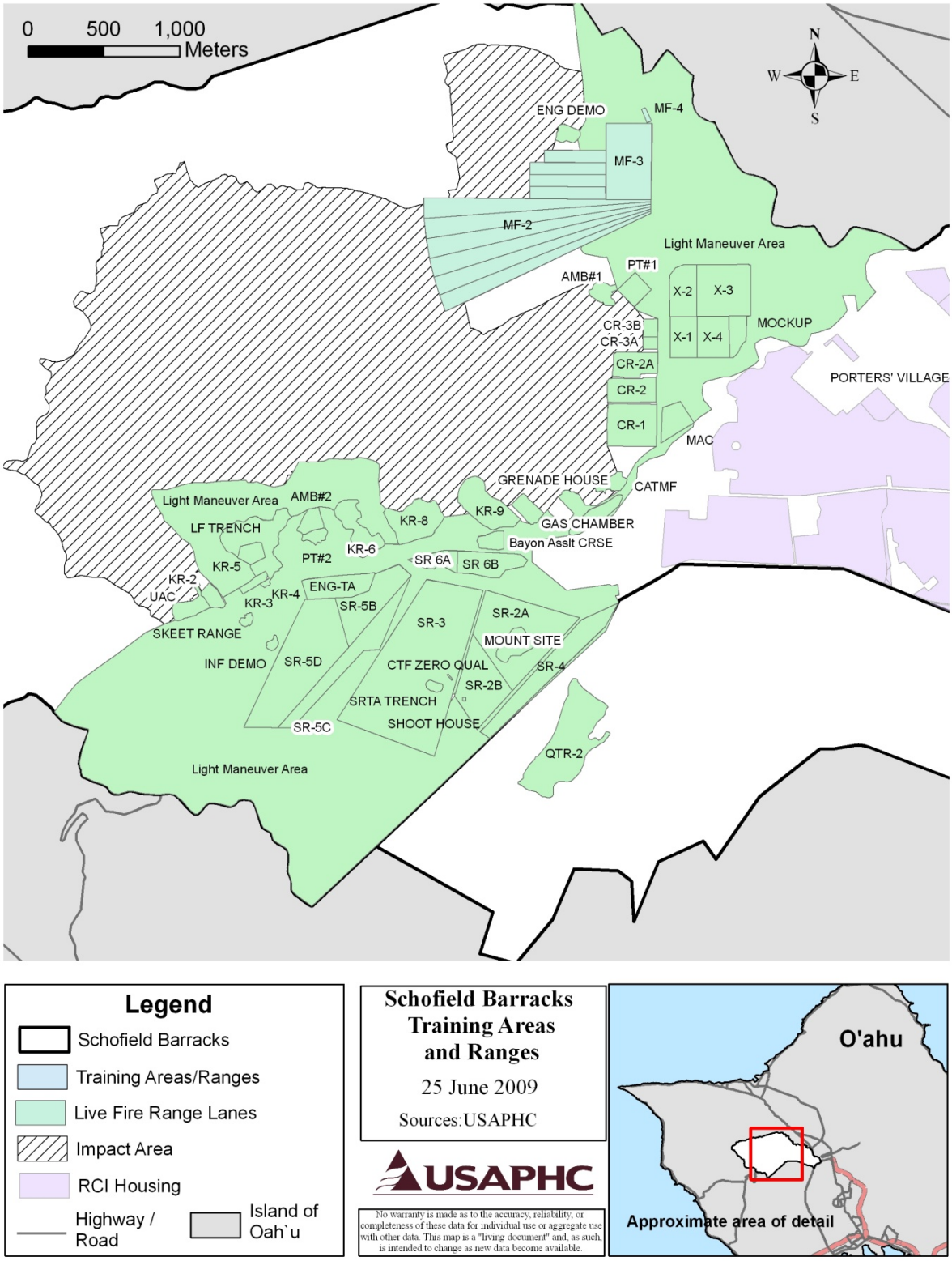

Figure 4-3 Schofield Barracks Military Reservation Training Areas and Ranges

4.4 CURRENT NOISE ENVIRONMENT

The principal sources of noise on SBMR are small arms and large caliber weapons firing.

Since there are multiple training activities occurring at any given time on SBMR, all of which have the ability to generate substantial noise, it is prudent to evaluate the sum of these activities rather than all the individual parts. In effect, this provides a "worst case scenario" for all firing operations on the installation. Therefore, all noise contours modeled for SBMR are for combined training operations unless stated otherwise. The noise contours consisted of operational data provided by SBMR from 01 October 2007 – 11 September 2008.

4.4.1 SMALL ARMS NOISE

A brief discussion of small arms firing in chapter two states that the "impact of a small arms range (i.e. live-fire) is relatively localized and thus, under most weather conditions, once a receiver is 1,000 meters from the range (behind the firing line), levels should not be high enough to annoy people". Although the majority of small arms ranges on SBMR are located to the interior of the installation, where noise from firing has a negligible effect off post, there are non-recommended land uses in the Residential Communities Initiative (RCI) family housing in the cantonment area (see Figure 4-3).

Conclusions:

- The combined peak level noise contours for small arms are illustrated in Figure 4-4. As mentioned above, the majority of the noise contours remain on the SBMR boundary with only the Zone II noise contour extending off post into areas of agricultural and preservation land uses. In addition, the computer modeling program (SARNAM) cannot take into account reflection or absorption of terrain, so the actual levels existing beyond the installation boundary may well be less than 87 dB PK15(met) due to the mountainous terrain surrounding the majority of the installation.

- The Zone III noise contours are contained within the installation boundaries; however a portion the RCI Housing is contained within Zone II.

- There are no non-recommended land uses off post within the Zone II noise contour but there are non-recommended land uses on post within the Zone II noise contours in the RCI housing area.

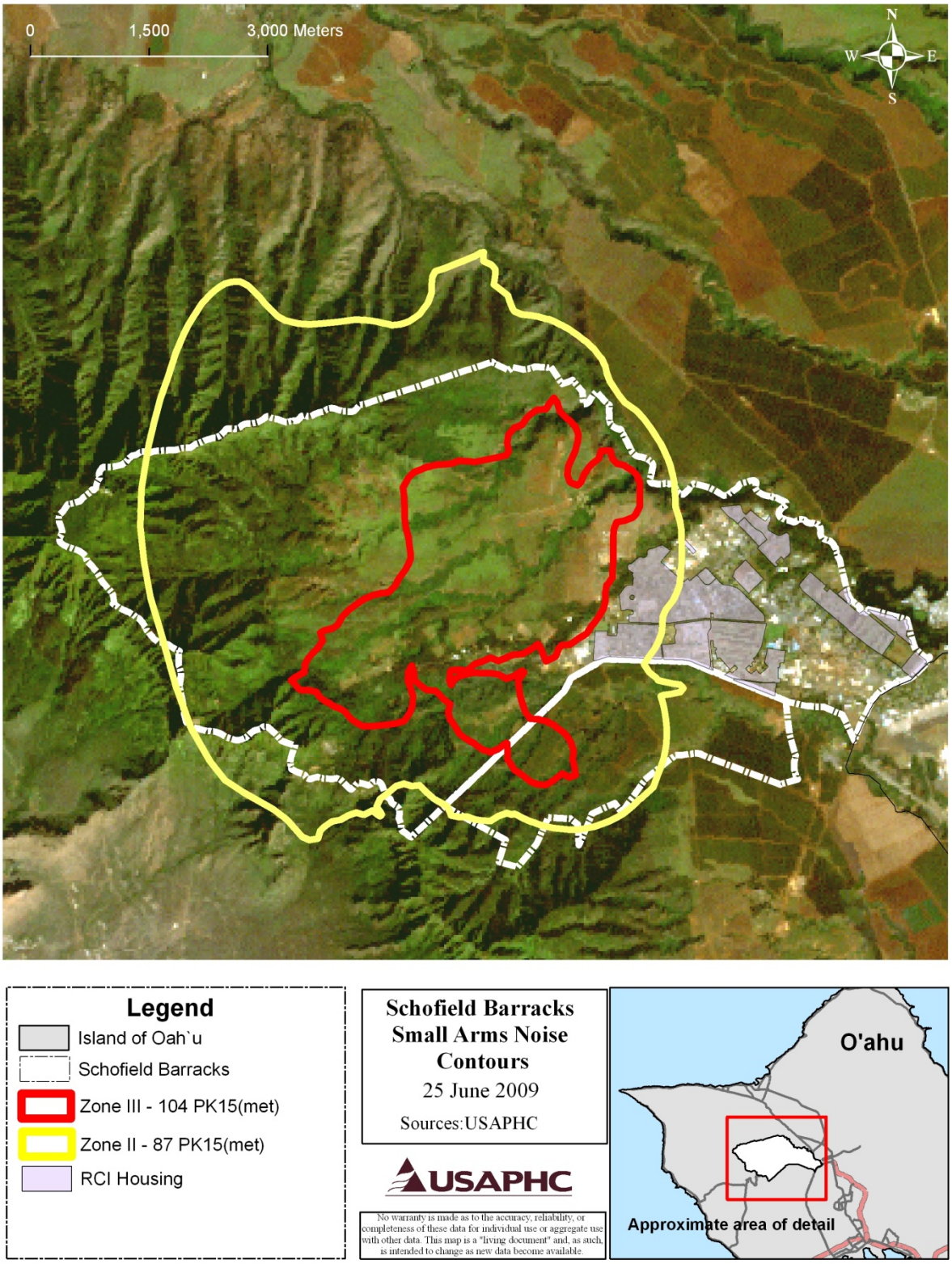

Figure 4-4 Schofield Barracks Military Reservation Small Arms Noise Contours

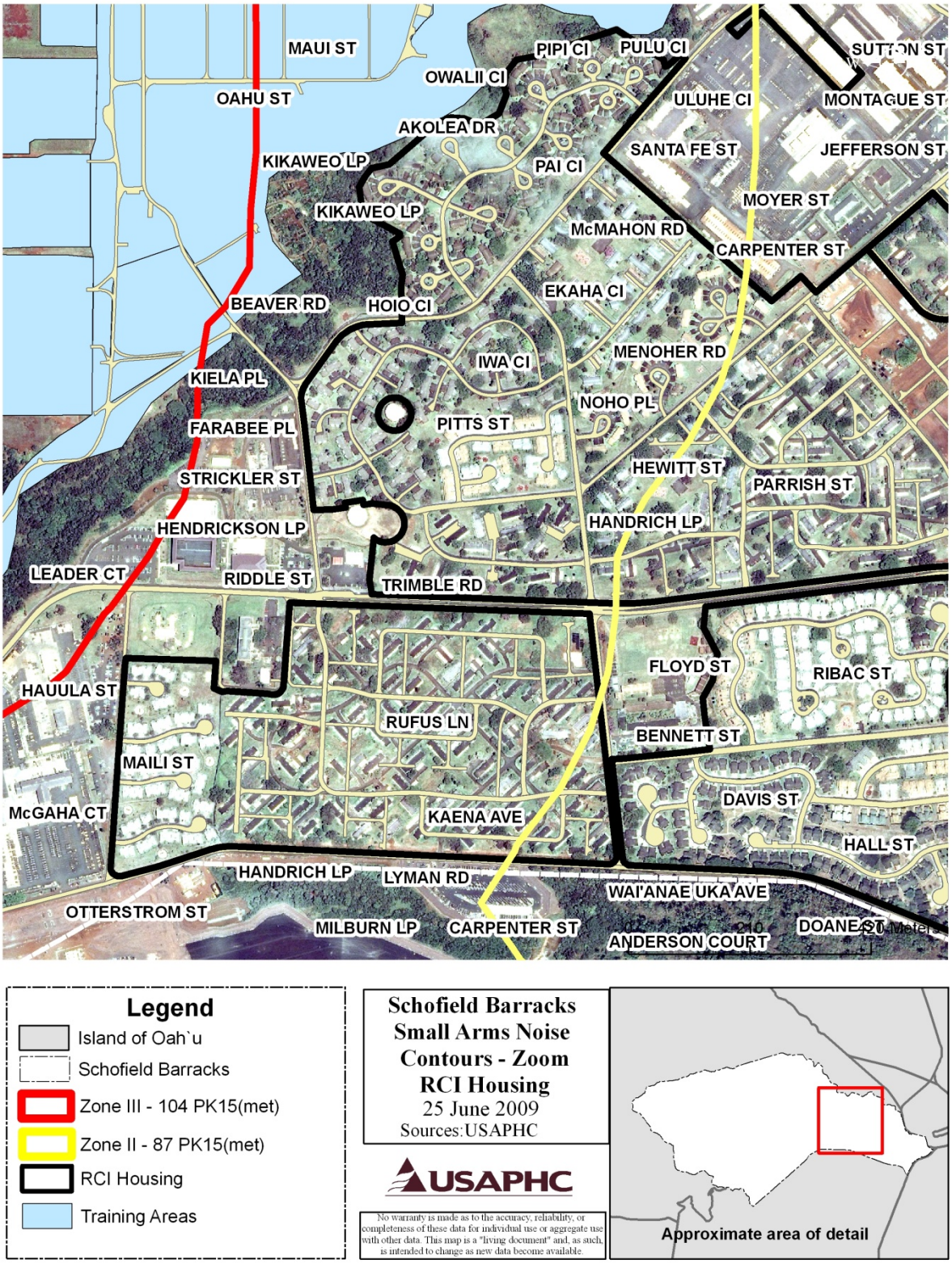

Figure 4-5 Schofield Barracks Military Reservation Small Arms Noise Contours and RCI Housing

4.4.2 LARGE CALIBER WEAPONS AND DEMOLITION NOISE

As previously mentioned, Army Regulation (AR) 200-1 defines noise zones and recommended land use guidelines for large caliber weapons noise using both the C-weighted DNL (CDNL) metric and the PK15(met) noise metric (Appendix F). The CDNL metric is effective for land use planning, as the CDNL is an average which shows exposure over a period of time (generally CDNL contours are averaged annually). However, experience at Army installations has shown that *complaints* from large caliber weapons and demolition training/testing are usually attributed to a single loud event, at a particular point in time, versus the average noise dose received at any one location. Often complaints are received from areas that are considered "acceptable" with the noise environment using the CDNL metric. To this end, the Army has adopted the practice of assessing large caliber weapons noise using both the CDNL metric along with a supplemental "complaint risk" PK15(met) metric.

The CDNL noise contours for the existing large caliber operations are shown in Figure 4-6. These contours are based on 2007/2008 ammunition expenditure data found in Appendix B and include all SBMR large caliber and demolition operations averaged over 250 training days.

<u>Conclusions:</u>

- The majority of the Zone III noise contours are contained on post except for an area approximately 360 meters off post to the north in an agriculturally zoned area. The Zone II and LUPZ noise contours extend off post to the north and south, but are contained entirely within agricultural and restricted preservation zoned areas. There are no incompatible land uses off post within the Zone II or Zone III noise contours.

- On post, the Zone II and LUPZ noise contours overlap the RCI housing area located east of the firing points (see Figure 4-6). There are non-recommended land uses on post (RCI Housing) within the Zone II noise zones.

- The moderate risk of complaints (115-130 PK15(met)) noise contour from existing operations training at SBMR (Figure 4-7) overlaps in the town of Wahiawa and Wheeler Air Force Base.

- On post, the high risk of complaints (>130 dB) noise contours overlaps the RCI housing area.

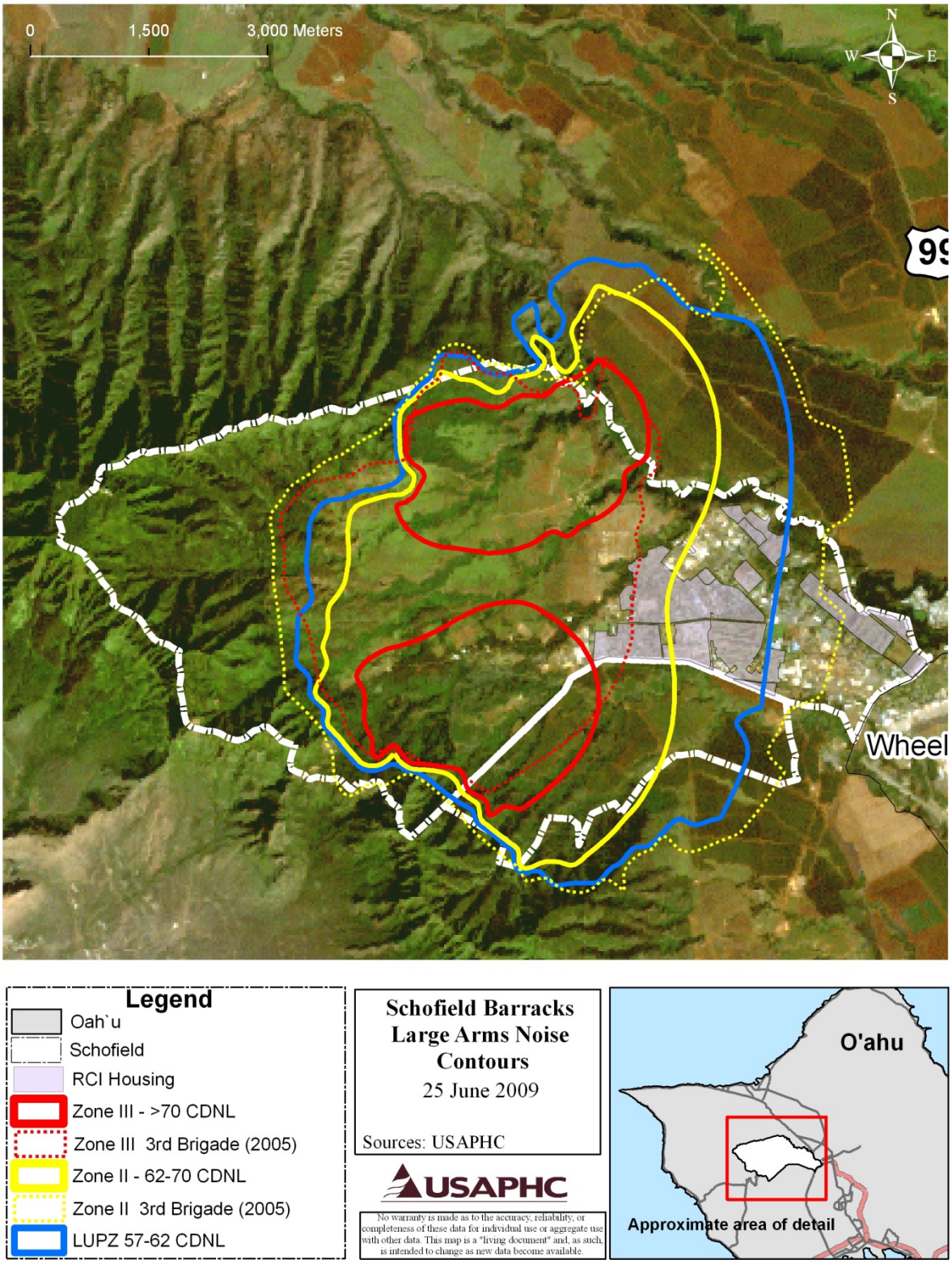

Figure 4-6 Schofield Barracks Large Arms Noise Contours (including 3rd Brigade 2005 Contours)

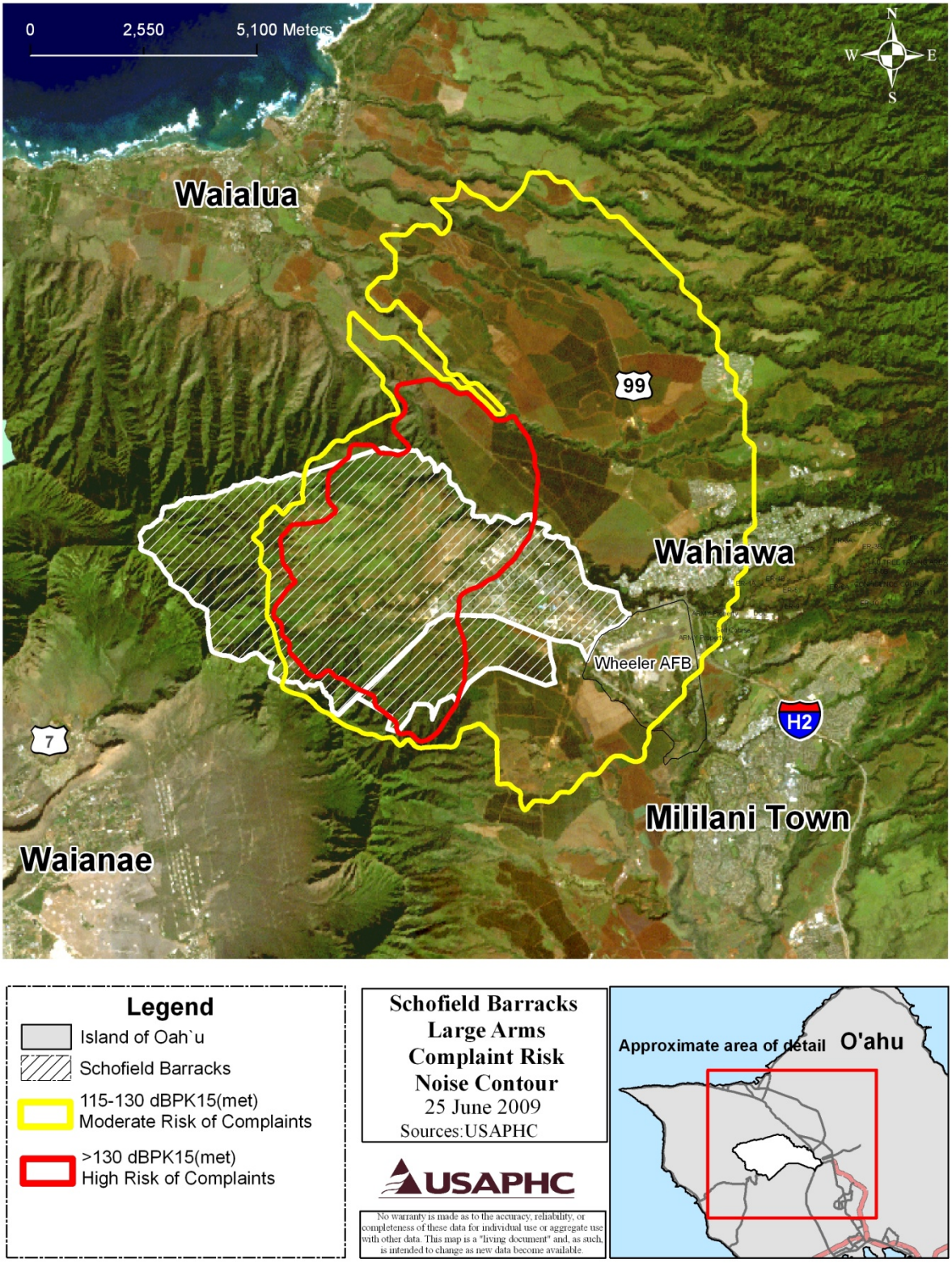

Figure 4-7 Schofield Barracks Large Arms Complaint Risk Noise Contour

5.0

SCHOFIELD BARRACKS EAST RANGE

5.1 GENERAL [17]

Schofield Barracks is divided into two main tracts of land, referred to as the Main Post and the East Range. The Schofield Barracks East Range (SBER) extends east of Kamehameha Highway (Route 99) (see Figure 5-1). The types of land uses at SBER include the school complex and maneuver training areas. The East Range area contains 21 square kilometers (5,154 acres) for training purposes of which 9 square kilometers are considered suitable for maneuver training.

The East Range is the site of Light Infantry Training Command (LITC), the 18-hole Leilehua Golf Course, the U.S. Army Noncommissioned Officer (NCO) Academy, warehouses assigned to various directorates in the United States Army Support Command, the 25th Infantry Division, 45th Support Group warehouses, and one Directorate of Logistics general support maintenance facility.

5.2 SURROUNDING LAND USES

Figure 5-2 shows the land use surrounding SBER as zoned agricultural, preservation, residential, and federal (Wheeler Army Airfield and Kawailoa Military Reservation.) The town of Wahiawa is located along the northwestern boundary of the SBER and Mililani Town is located approximately 500 meters from the southern boundary. A "buffer zone" exists between SBER and Mililani Town consisting of industrial, agricultural, federal, and preservation land.

[17] http://www.globalsecurity.org/military/facility/schofield-barracks.htm

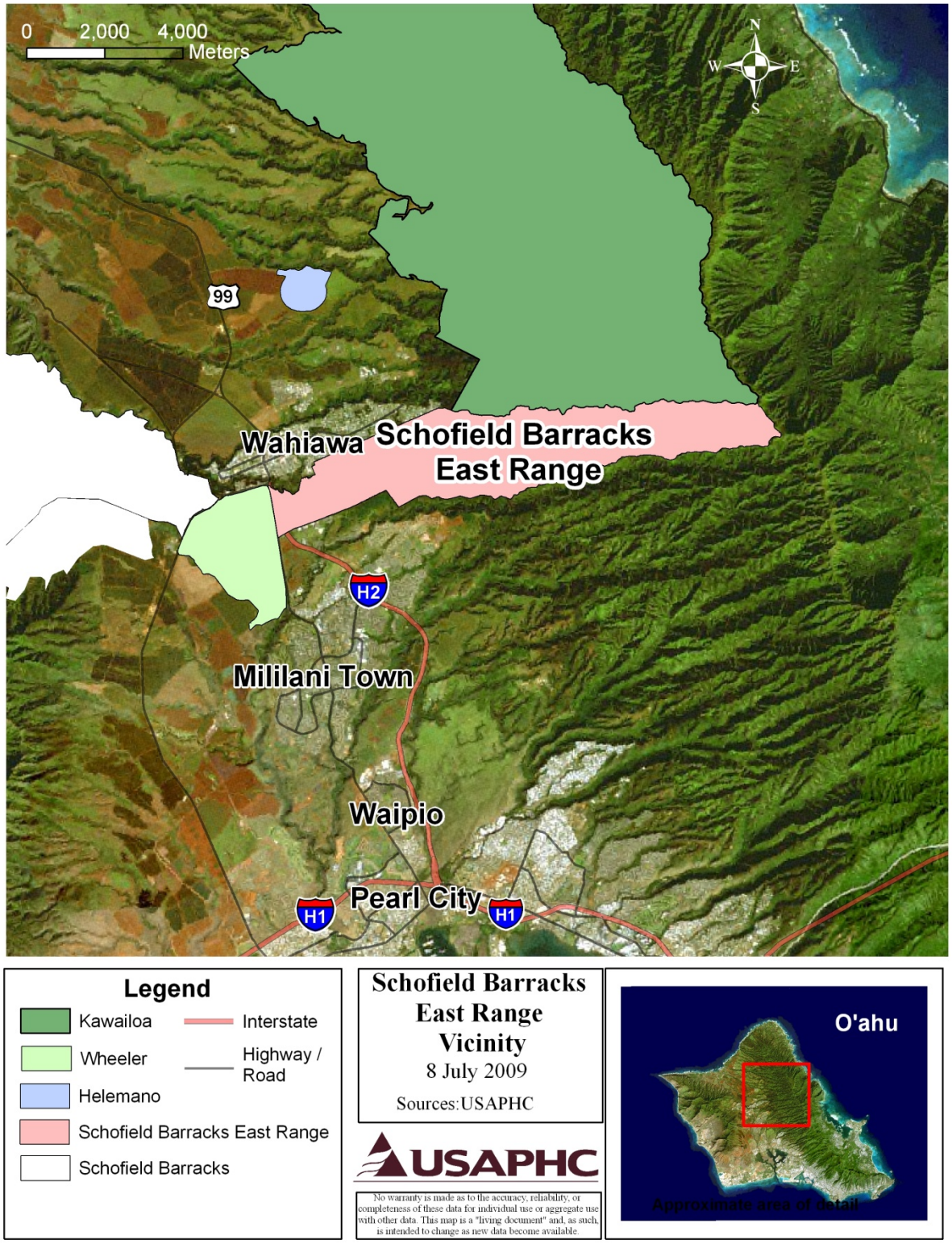

Figure 5-1 Schofield Barracks East Range Vicinity

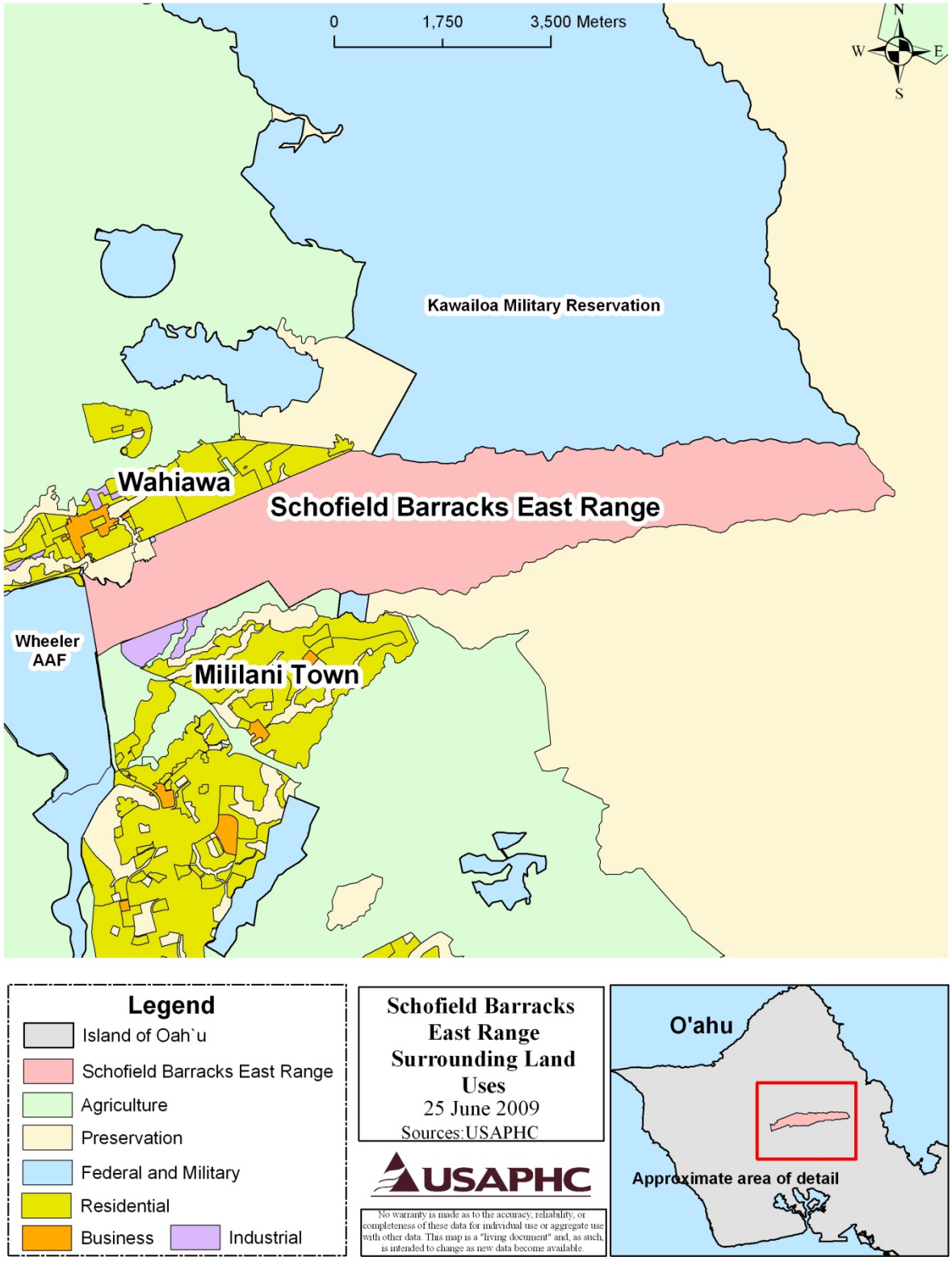

Figure 5-2 Schofield Barracks East Range Surrounding Land Uses

5.3 TRAINING

The SBER provides training areas (Figure 5-3) for the infantry division stationed at the post and for the tactical field exercises of other units of the U.S. Army and the U.S. Marine Corps. The SBER's western maneuver area comprises approximately 9 square kilometers (2,223 acres). This area is valuable for rappelling, jungle survival, and patrolling operations. Several open areas allow for Air Assault and Airborne operations. Unit level uses include limited battalion and company level Army Training and Evaluation Program (ARTEP) missions. Climate, terrain, and vegetation provide excellent training for Pacific and Asian Theater of Operational readiness.

Live ammunition, aerial pyrotechnics (star clusters / parachute flares), and noise producing simulators and grenades are not authorized at Schofield Barracks East Range. Training is limited to blank ammunitions (7.62mm, and 5.56mm) with a US Army Hawai`i range regulation standoff distance of 500 meters from the boundary line. The .50 CAL blank is not currently utilized at SBER; a special request would have to be approved by the Range Control Manager.

Due to the bordering residential area of Wahiawa to the north, the noise abatement hours for East Range ER-1A/B, ER-2, ER-3A/B training area are from 1800-0600 hours.

Training Area (SB-ER)	Type
1A/1B 2 3A/3B 4 5 6A/6B 9 10 11 12 13 KU TREE TRNING AREA	**MANEUVER/TRAINING AREA, LIGHT FORCES -** Space for ground and air combat forces to practice movements and tactics as specified in the unit's Army Training and Evaluation Program (ARTEP). Different type units may work in support of one another (combined arms), or a unit may operate on its own to practice a specific set of ARTEP tasks. The "light" designation refers to areas where maneuver may be restricted for some reason to only small units or units having only wheeled vehicles. "Light" maneuver/training areas are not typically used by "heavy" forces other than assembly areas where movement is restricted to roads or trails.
AIR ASSAULT/JTC	**RAPPELLING TRAINING AREA -** A training area that includes at least one structure used to practice rappelling (rope descent). The training area may also include modified towers for training in helicopter rappels.
CONFIDENCE COURSE	**CONFIDENCE COURSE -** A structure designed for developing individual soldier confidence and strength through a series of obstacles. No automation is required for this facility. A latrine (73075) and operations/storage building (17122) are associated with the facility. Count each complete course as 1 EA.

Table 5-1 Schofield Barracks East Range Training Area Description

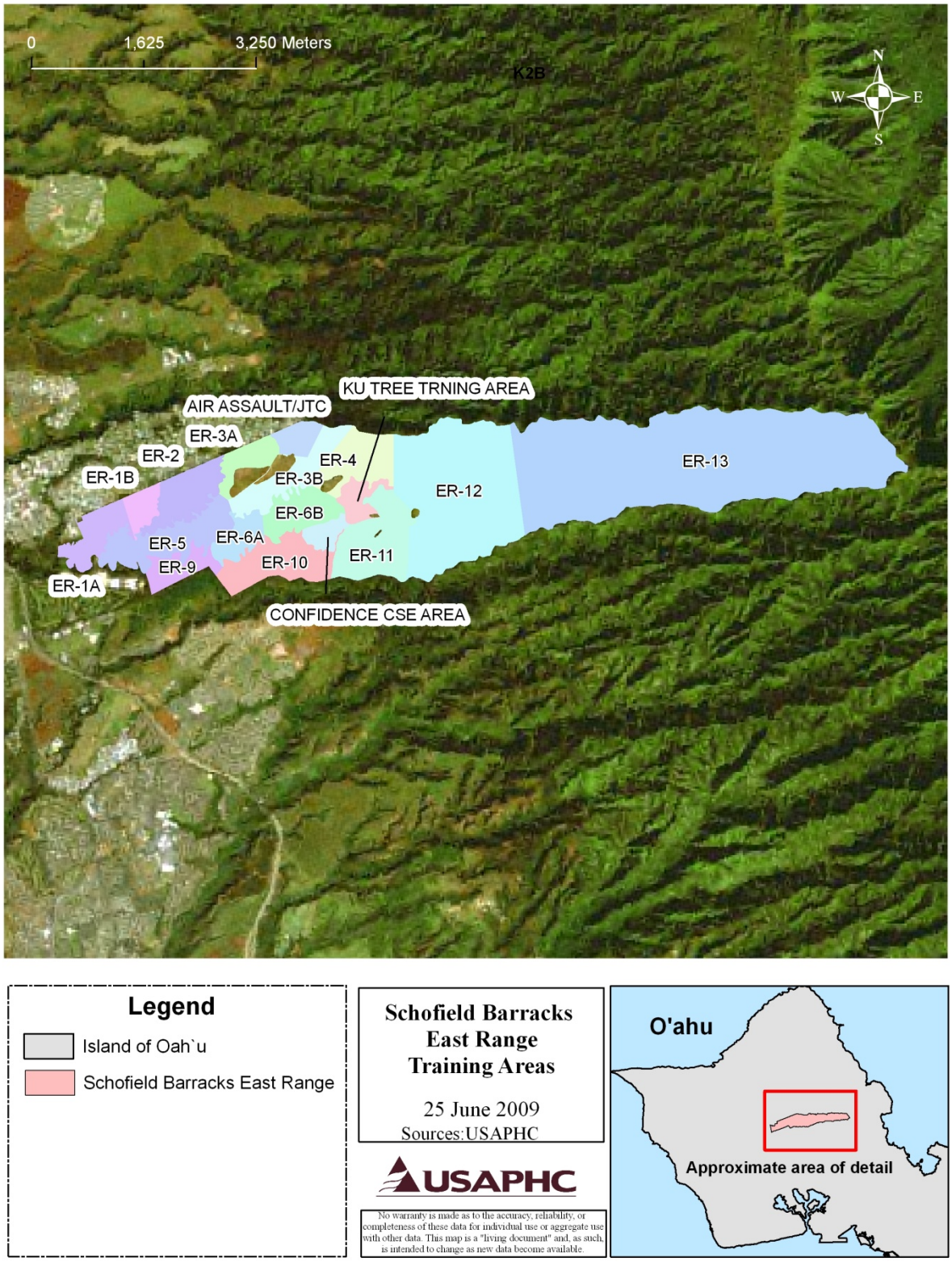

Figure 5-3 Schofield Barracks East Range Training Areas

5.4 CURRENT NOISE ENVIRONMENT

The principal sources of noise on SBER are generated through small arms blank firing.

5.4.1 SMALL ARMS NOISE

To generate contours using SARNAM, specific firing point and target point locations must be entered into the computer. Training at SBER consists of blank rounds (7.62 mm, and 5.56 mm) where there are no set firing point or target point locations; firing can occur at multiple locations and in multiple directions during ARTEP missions. Therefore, noise contours for this mobile activity cannot be modeled using SARNAM.

However, by looking at the predicted peak levels for the loudest weapon used (7.62 mm blank) provided in Table 5-2, we can see that noise approaching Zone II levels [PK15(met) 87 dB] would extend out approximately 800 meters from the source. By subtracting the 500 meter Schofield range regulation standoff distance, it could be inferred that 300 meters off post would be the furthest extent that noise from small arms firing could approach Zone II limits. However, due to the mountainous terrain surrounding the majority of the installation, levels approaching Zone II limits for rifling firing probably would not extend the full 300 meters beyond the installation boundary. In addition, a 100 meter buffer of forests exists between the training areas and town of Wahiawa (Figure 5-4). From Table 5-3, 100 meters (300 feet) of medium growth forest would equate to a small amount of additional attenuation for small arms (blank) training, thus noise levels may be slightly lower than expected.

	Predicted Level, dBP Azimuth		
Distance, meters	**0°**	**90°**	**180°**
50	116-126	113-123	106-116
100	109-119	106-116	101-111
200	103-113	100-110	94-104
400	92-102	89-99	85-95
800	**84-94**	**81-91**	**77-87**
1600	75-85	72-82	69-79

TABLE 5-2 Predicted Peak for MG 50 Cal Blank

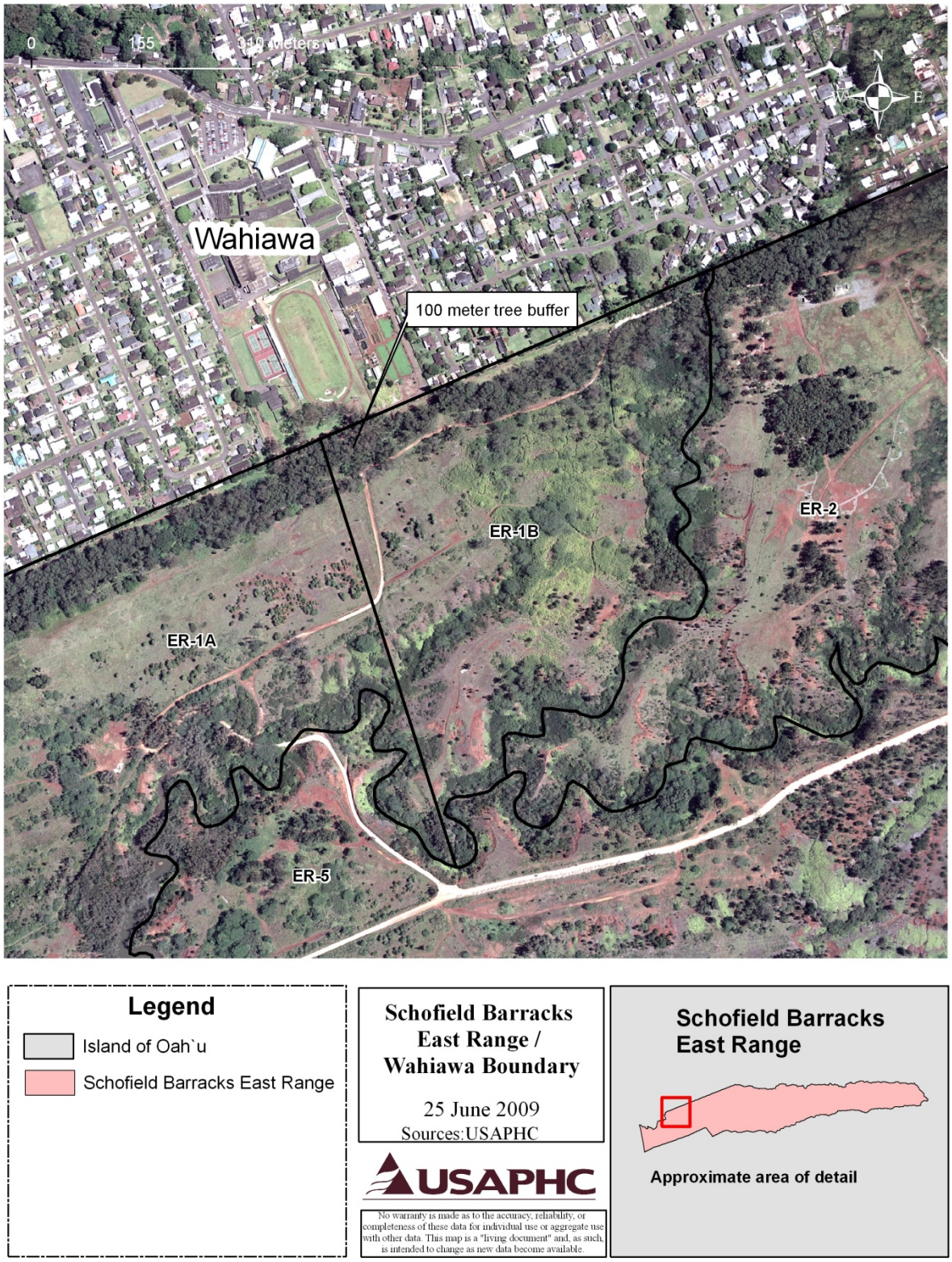

Figure 5-4 Schofield Barracks East Range and Wahiawa Boundary

Octave Frequency Band, HZ	Insertion Loss, dB per 100 ft. of Woods
31	0
63	1/2
125	1
250	1 1/2
500	2
1000	3
2000	4
4000	4 1/2
8000	5

TABLE 5-3 Insertion Loss for Through a Growth of Medium Dense Woods [18]

[18] UFC 3-450-01 Noise and Vibration Control, Department of Defense 15 May 2003

6.0

WHEELER ARMY AIRFIELD

6.1 GENERAL [19]

Wheeler Army Airfield (WAAF) is located in the middle of the Central O`ahu Plateau between the Waianae and Koolau mountain ranges. WAAF is surrounded by the towns of Wahiawa to the north, Mililani Town to the south east, and pineapple fields to the south west. WAAF lies directly between Schofield Barracks Main Post and Schofield Barracks East Range (Figure 6-1). The installation is approximately 22 miles from downtown Honolulu and lies at nearly 835 feet above Mean Sea Level (MSL). WAAF encompasses 1,389 acres of land and is the fourth largest Army installation on the island.

Wheeler Army Airfield is a sub-installation of Schofield Barracks and is assigned to Commander, United States Army Garrison, Hawai`i. Its mission is to provide administration, housing, maintenance, training, and flight facilities for peacetime mission requirements, encompassing installation security and law enforcement support. The base's primary function is aviation operations in support of the 25th Infantry Division and the United States Army Hawai`i (USARHAW).

WAAF is serviced by a single, category "A" runway designated as 06/24, which has a length of 5,600 feet and a width of 300 feet.

6.2 SURROUNDING LAND USES [20]

Many business establishments and hotels have developed the land surrounding WAAF to the north in the town of Wahiawa and south east in the town of Mililani Town. The fertile land has also proven to be a means of resource for residents near the Army airfield. Pineapple and other Hawai`ian crop plantations grown nearby to the south west and are sold at local food markets. The majority of the land use surrounding WAAF is designated agricultural and federal (Schofield Barracks, Schofield Barracks East Range). The two exceptions would be the residential areas of Wahiawa bordering north and Mililani Town located south east.

[19] http://en.wikipedia.org/wiki/Wheeler_Army_Airfield
[20] http://en.wikipedia.org/wiki/Wheeler_Army_Airfield

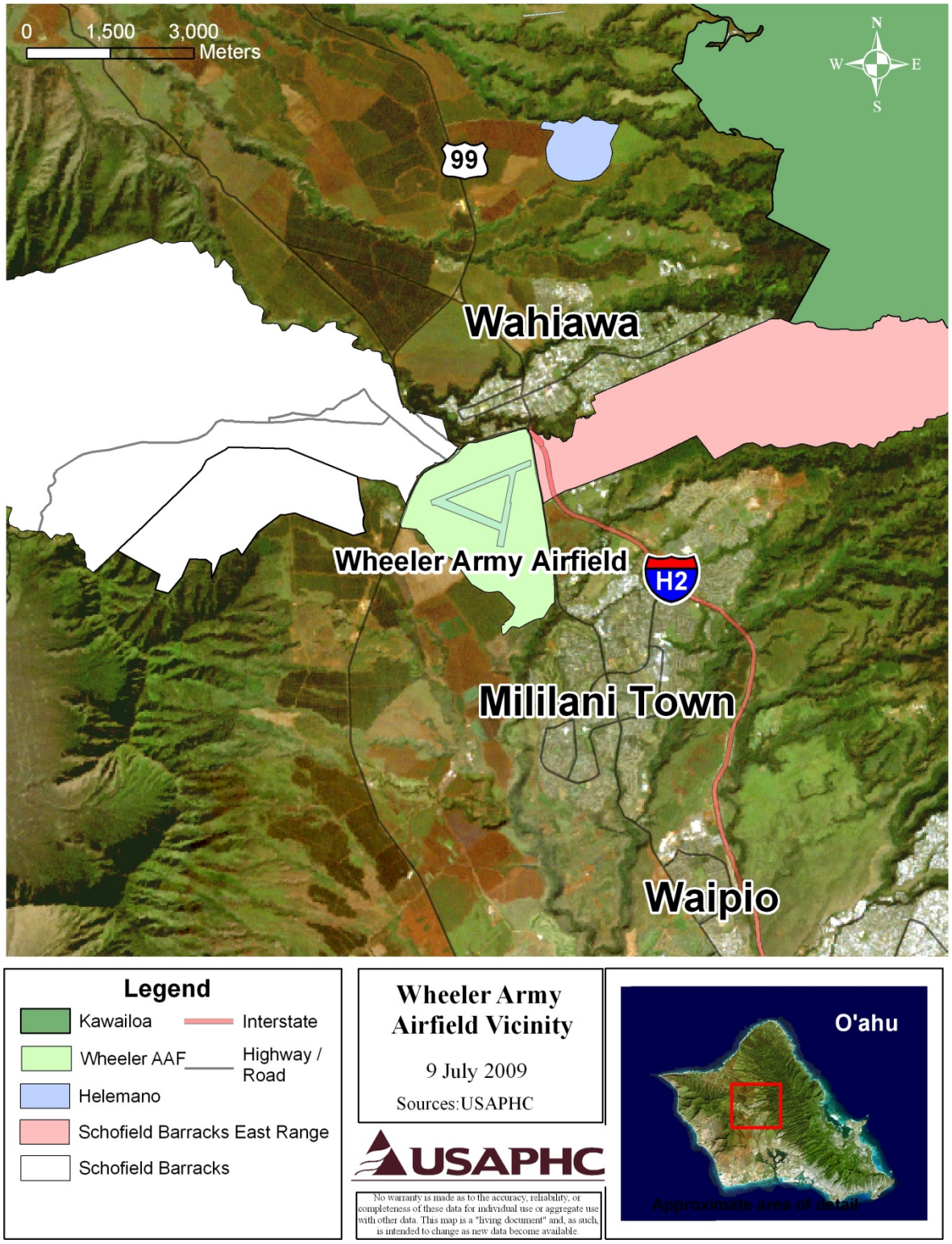

Figure 6-1 Wheeler Army Airfield Vicinity

6.3 TRAINING

WAAF's primary function is aviation operation and support for the 25th Infantry Division and other units of the USARHAW. The types of aircraft utilizing the WAAF airfield include: CH-47, CH-53, OH-58, UH-60, C-130, Single Engine Props, and Twin Turbo Prop.

The WAAF personnel provided operational data for the month of June 08 (Table 6-1). The flight data indicated the majority of operations (77%) consisted of UH-60 Blackhawk and CH-47 Chinook aircraft. Also, night operations consisted of 39% of the total airfield activity. It is noted that every night time event equates to 10 day time events when calculating the A-weighted Day-Night average sound Level (ADNL) which is detailed in Appendix A.4.2.

Aircraft Type	Daytime Activity (0700-2200)	Nighttime Activity (2200-0700)
CH-47	1,014	649
CH-53	203	129
OH-58	609	389
UH-60	2,029	1,297
C-130	54	34
Single Engine Prop	34	21
Twin Turbo Prop	26	17

TABLE 6-1 Wheeler Army Airfield Traffic Count (June 2008)

Aircraft Type	Daytime Activity (0700-2200)	Nighttime Activity (2200-0700)
CH-47	51	32
CH-53	10	7
OH-58	30	20
UH-60	101	65
C-130	2	2
Single Engine Prop	2	1
Twin Turbo Prop	2	0

TABLE 6-2 Wheeler Army Airfield Average Daily Traffic Count

6.4 CURRENT NOISE ENVIRONMENT

6.4.1 AIRCRAFT NOISE

As previously mentioned in Section 2.3.4.6, Army Regulation (AR) 200-1 defines noise zones and recommended land use guidelines for aircraft noise using the A-weighted DNL (ADNL) metric **(**Appendix F**).** The ADNL metric is effective for land use planning, as the ADNL is an average which shows exposure over a period of time (generally ADNL contours are averaged annually). Several computer models are used to visualize aircraft noise but the most common is NOISEMAP/BASEOPS used for land use planning.

The ADNL noise contours for the existing aircraft operations at WAAF are shown in Figure 6-2 through Figure 6-7. These contours are based on June 2008 data provided by WAAF personnel.

Conclusions:

- The recent Aviation Brigade request for an additional hour (2200-2300) will have a minimal effect on the noise zone contour found in Figure 4-2, though single events could cause alarm with nearby neighborhoods. Pilots should be aware of noise sensitive areas and practice established noise abatement procedures. Pilots should also be informed of the "Fly Neighborly' program and guide which is found at :

  http://www.rotor.com/portals/12/Fly%202009.pdf

- The Zone III noise contours are contained on WAAF property except for a very small region that overlaps the Schofield Barracks East Range and is compatible with the noise environment. There are no incompatible land uses on or off post within the Zone III noise contours. (See Figure 6-3, Figure 6-4, and Figure 6-5 for detailed views)

- The Zone II noise contours exist off post but are contained entirely within agricultural, preservation, federal, and industrial zoned land. There are no incompatible land uses off post within the Zone II noise contours. On post, one WAAF RCI housing unit is within the Zone II (see Figure 6-3).

- The LUPZ encompasses portions of the RCI Housing at Schofield Barracks and a small residential region of Mililani Town. On post, the WAAF RCI Housing and Wheeler Elementary and Middle schools are within the LUPZ.

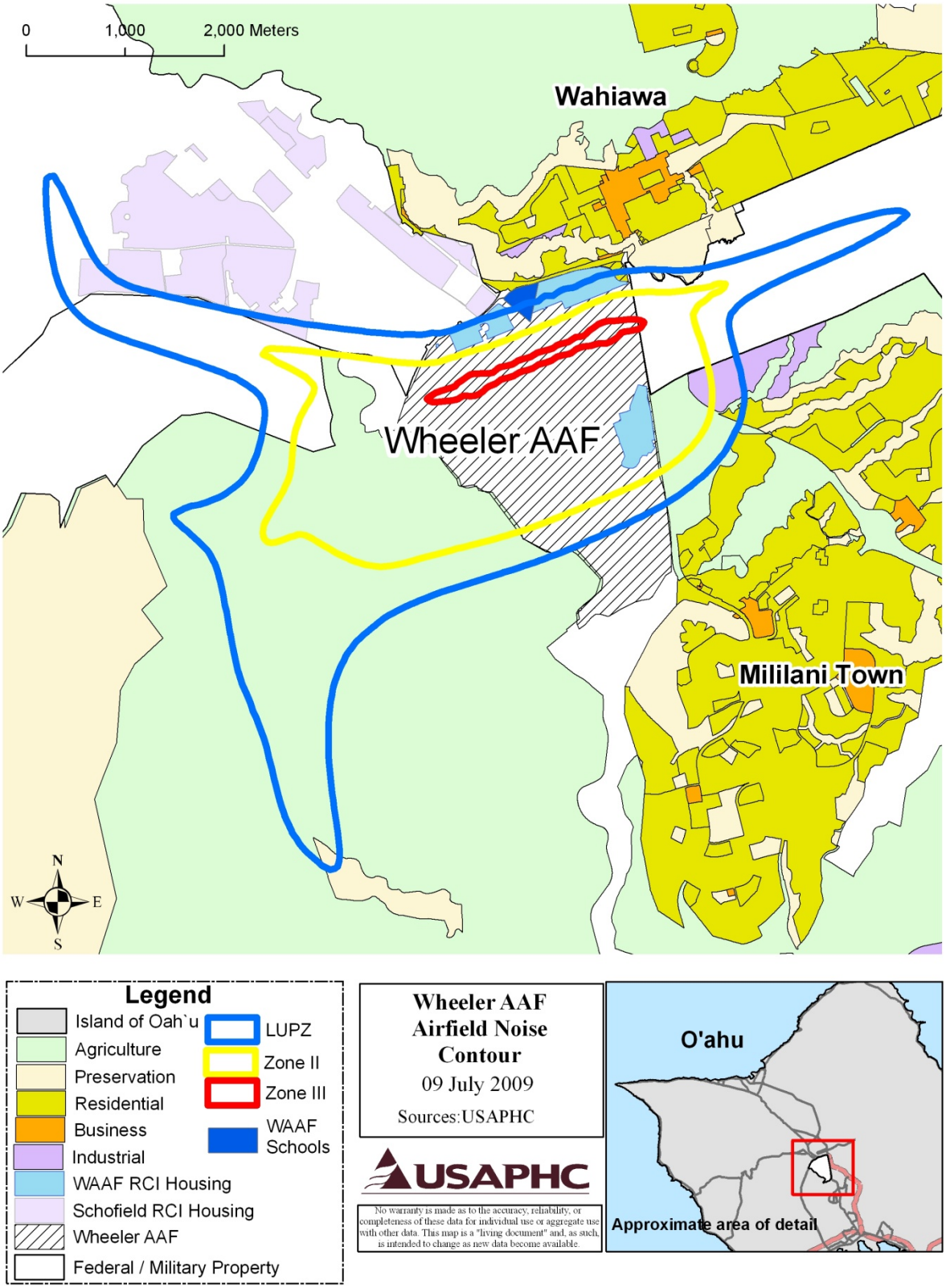

Figure 6-2 Wheeler Army Airfield Noise Contour

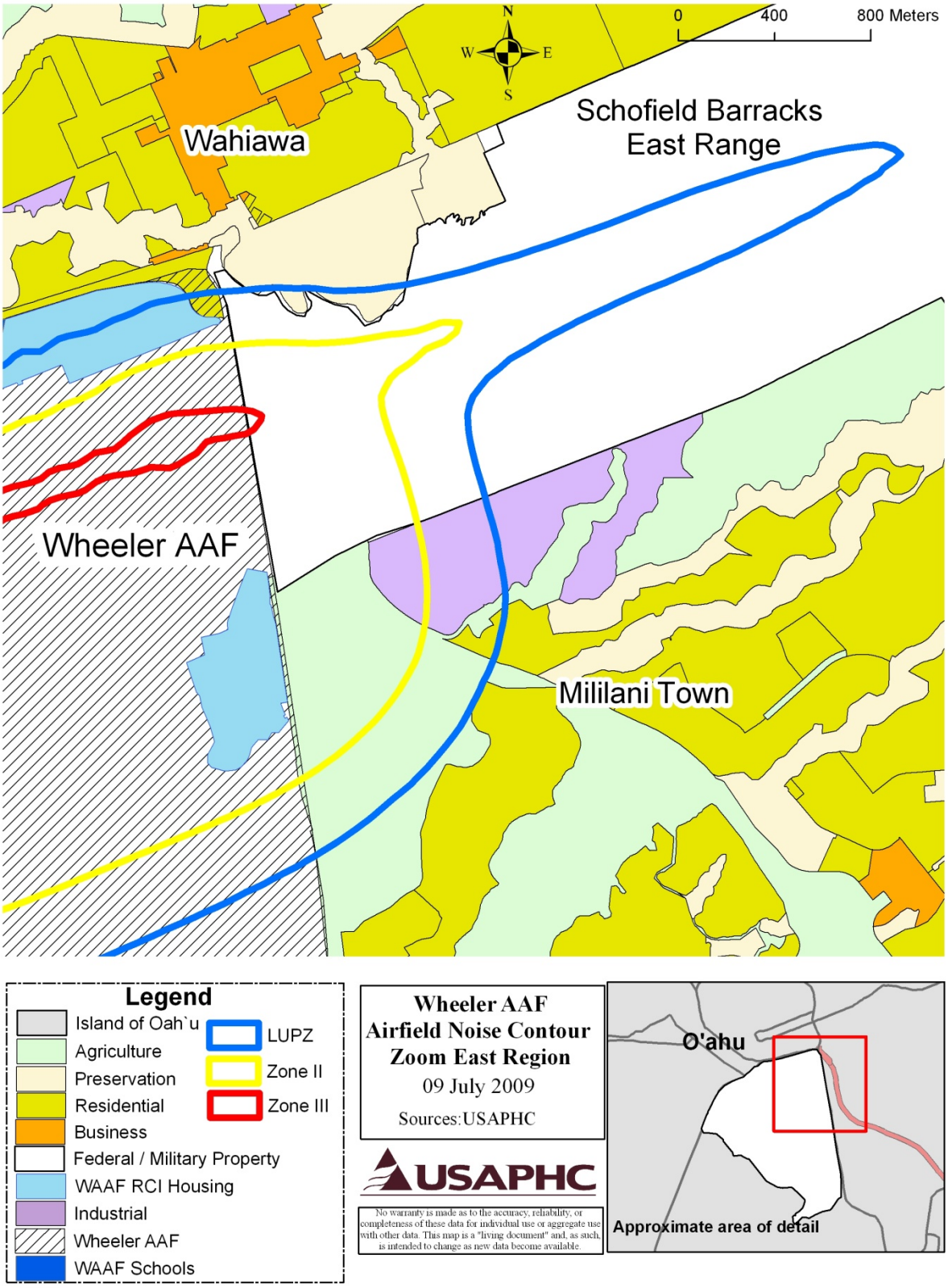

Figure 6-3 Wheeler Army Airfield Noise Contour Zoom East Region

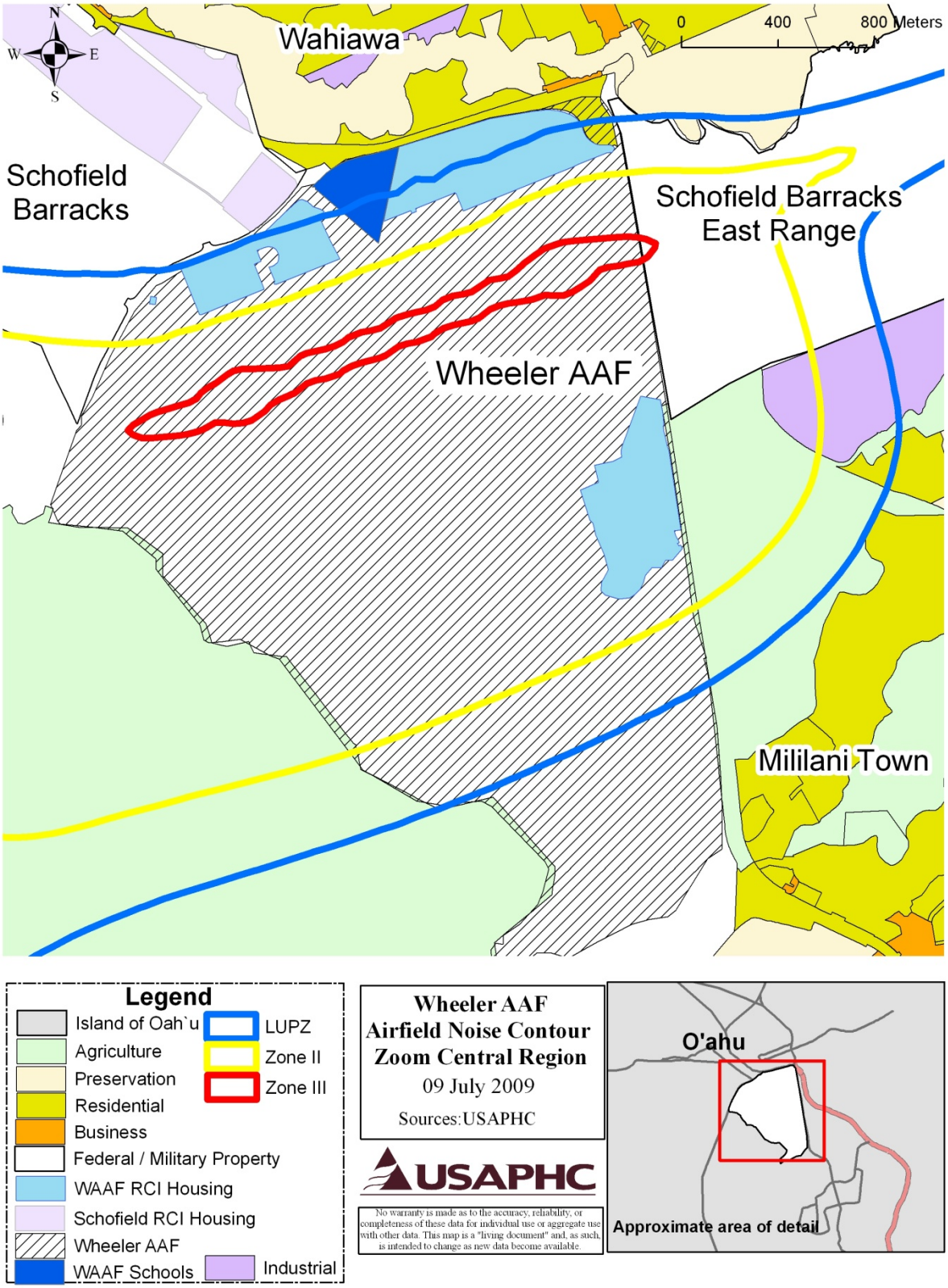

Figure 6-4 Wheeler Army Airfield Noise Contour Zoom Central Region

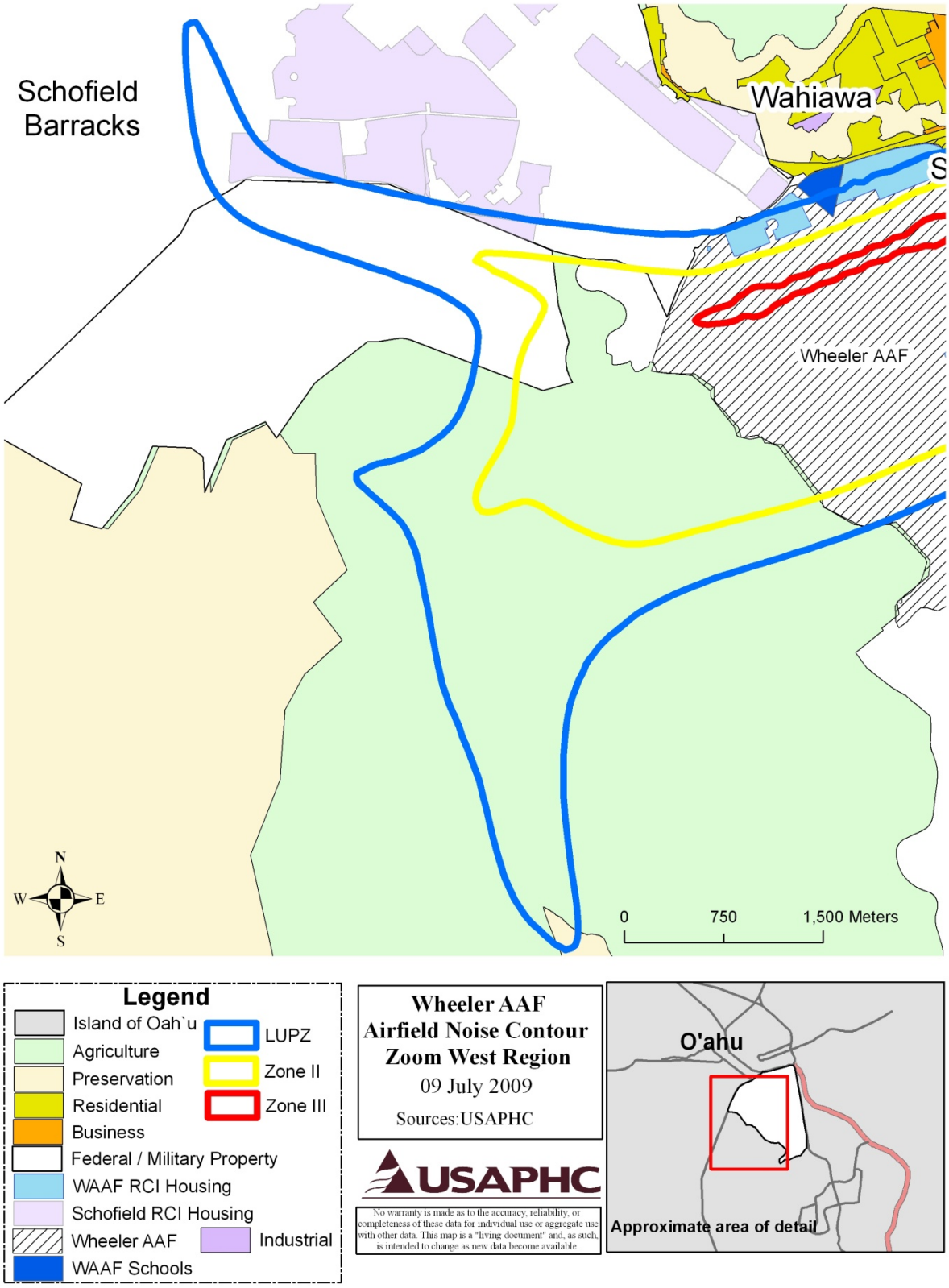

Figure 6-5 Wheeler Army Airfield Noise Contour Zoom West Region

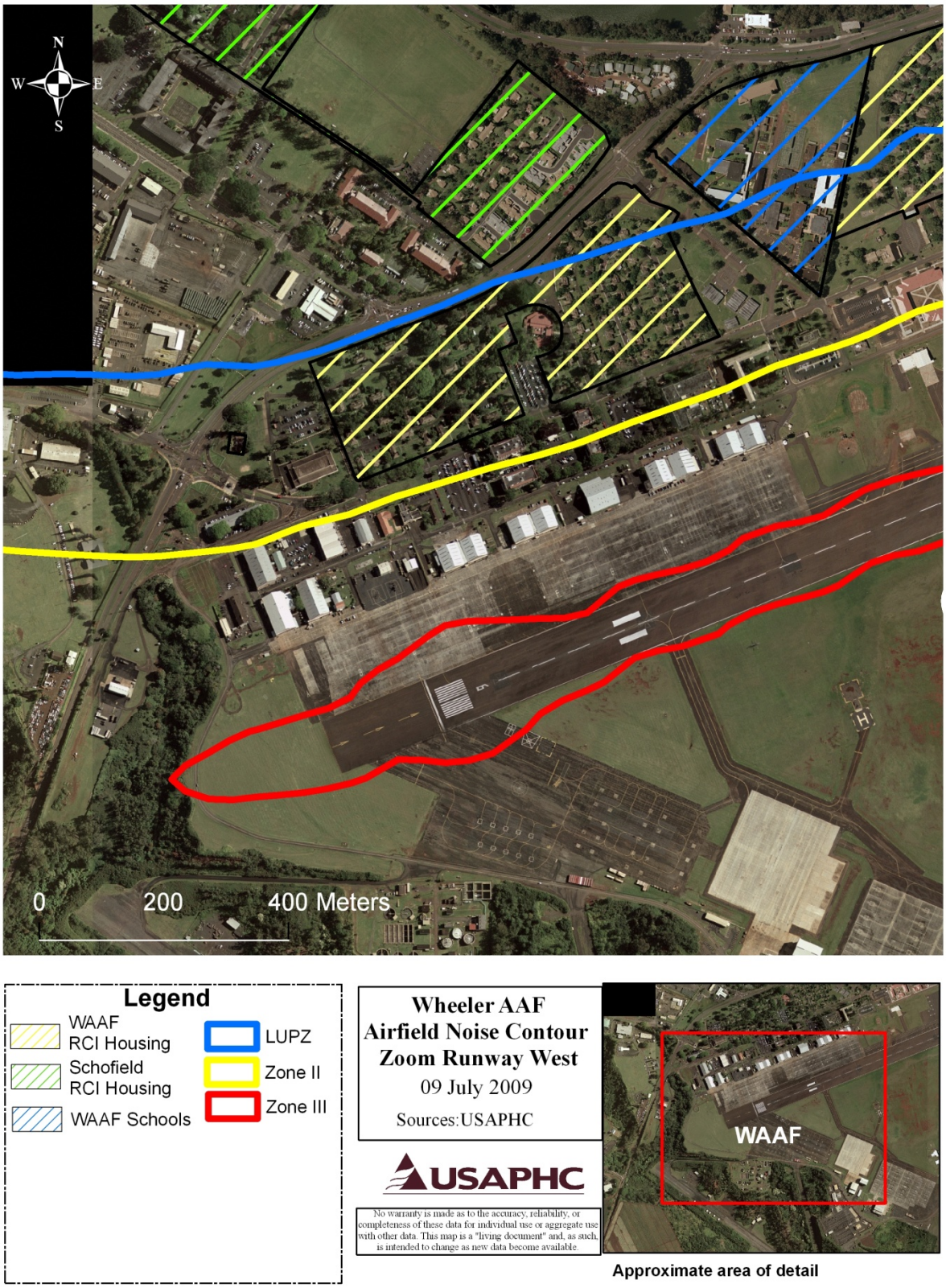

Figure 6-6 Wheeler Army Airfield Noise Contour Zoom Runway (West Region)

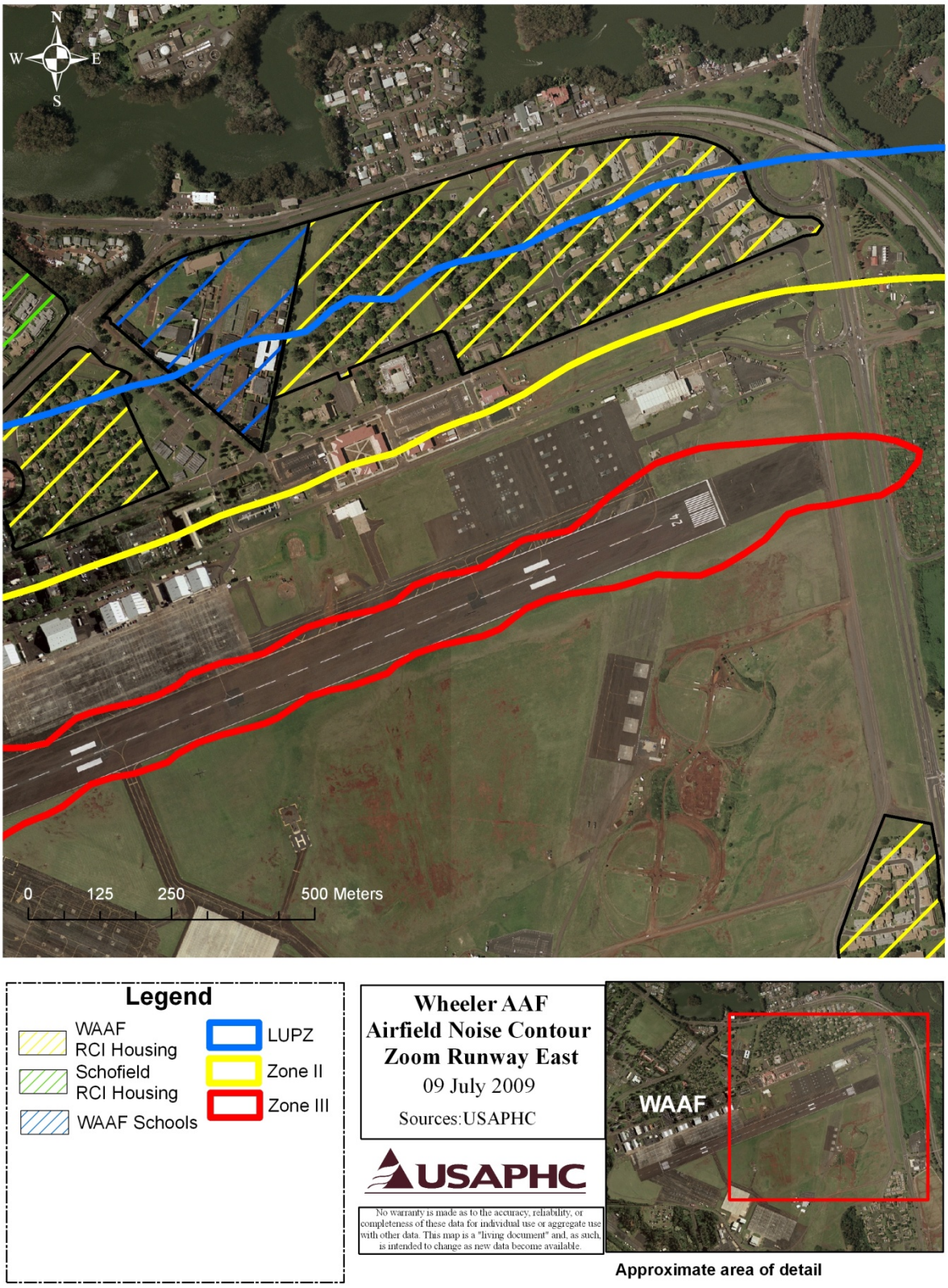

Figure 6-7 Wheeler Army Airfield Noise Contour Zoom Runway (East Region)

6.5 AIRCRAFT NOISE ABATEMENT

To abate aircraft noise, pilots are trained to avoid unnecessary over flight of populated areas as well as single houses. In order to gain public acceptance, all pilots are trained to be sensitive to the concerns of the surrounding communities. The 25th ID Aviation Officer has designated noise sensitive areas which are shown in Figure 6-6.

From the Draft USAG-HI Installation IASC SOP (August 2008), Section IV details a "Noise Abatement and Fly Neighborly" policy for WAAF. Below details the procedure from the plan:

PROCEDURES.

a. Operations at WAAF from 2300L to 0600L daily are restricted to departures, arrivals, and refueling operations (no closed traffic).

b. The only authorized landing areas on Schofield Barracks are Pad 4 and Dragon X. Landing at any other area requires coordination with the Assistant Division Aviation Officer (ADAO) and a safety survey by the supporting unit.

c. Terrain flight training will be conducted only on the Schofield, Makua, Dillingham or Pohakuloa Military Reservations, or in a Tactical Flight Training Area (TFTA).

d. Overflight of designated noise sensitive areas below 3000 feet MSL (O`ahu) or 2000 feet AGL (Big Island) is prohibited unless complying with paragraph f. below.

e. WAAF Base Operations will maintain a master map of all designated noise sensitive areas for the island of O`ahu. WAAF Base Operations will maintain a fiscal year sequential log of changes to facilitate posting. Units will:

(1) Post a copy of the map in their respective flight planning areas for pilot use. WAAF Base Operations will alert units to additions and changes to the master map via NOTAM.

(2) Update their flight planning maps as NOTAMs are published.

(3) Verify the updates from the master map quarterly (October, January, April, July) and will post the date updated on their unit map.

f. When operating in areas other than the TFTA, military reservations or designated noise sensitive areas, pilots will maintain a minimum of 1000 feet AGL, with the following exceptions:

(1) When adhering to published routes and the altitudes associated with these routes. Published routes may be found in the following publications:

(a) DOD flight information publications (FLIP).

(b) Hawai`i Airports and Flying Safety Manual.

NOTE:
Aircrews are requested to restrict practice instrument approaches over Mililani and Wahiawa to essential flights only and to increase minimum descent altitudes (MDA) of practice approaches as much as practical while still maintaining weather requirements.

(2) When complying with these altitudes would violate basic VFR weather minimums. Pilots are urged to use alternate routes if weather will not permit flight at the published route altitude.

(3) When conducting flights in support of civilian law enforcement or public safety agencies.

(4) When on an NVG formation flight conducted over unpopulated areas (examples: Molokai and the Big Island). The route(s) must be reconned during daylight at the altitude to be flown NVG. The route(s) must a have a minimum of 2000 feet lateral clearance from any populated or posted noise sensitive areas and a minimum of 1000 feet lateral clearance from any single dwelling. Minimum NVG mission altitude will be 500 feet AGL. Approval authority for these NVG formation flights will be no lower than Battalion/Squadron Commander.

(5) Overwater tactical flights may be conducted at less than 1000' ASL when flown further than ¼ nm from the shoreline.

g. Aircraft transitioning along shorelines will remain a minimum of 1/4 nautical mile (nm) off shore or 1000 feet above the highest obstacle (AHO) within 2000 feet laterally, unless complying with paragraph f. above.

h. Intentional flight within 1000 feet, vertically or laterally, of a whale or whale pod is prohibited by federal law. If flying below 1000 feet above the surface and these animals are observed, alter flight path so as to avoid them by 1000 feet.

i. Pilots are reminded to avoid overflight of National Parks and Wildlife Refuges below 2000 feet AGL.

j. No over flight of livestock.

k. Aircraft conducting external load missions will avoid overflight of built-up/populated areas.

l. Intentional flight within 1000 feet, vertically or laterally, of any surface vessel is prohibited.

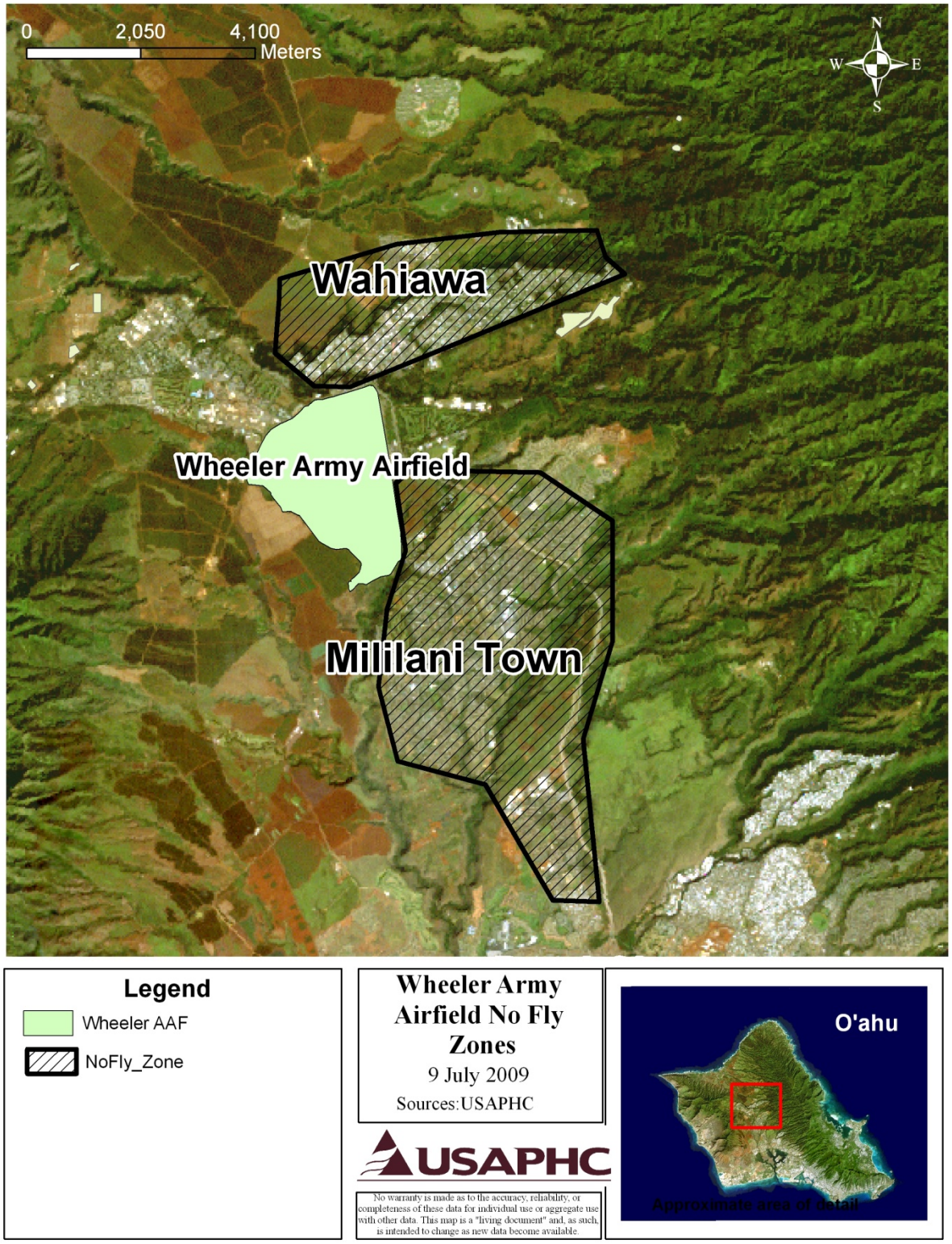

Figure 6-6 Wheeler Army Airfield No Fly Zones

(Intentionally Blank)

7.0
MAKUA MILITARY RESERVATION

7.1 GENERAL

The Makua Military Reservation (MMR) is located in an amphitheater-shaped valley near the northwestern tip of O`ahu and is a sub-installation of Schofield Barracks (see Figure 7-1). The Makua Military Reservation is the largest training area on O`ahu that will support both maneuver and live fire training, including limited attack helicopter live fire training and explosive ordnance operations. All small arms weapon systems integral to the 25th Infantry Division can be conducted, including limited attack helicopter live fire training. Long-range weapon systems, including 155-mm artillery and 2.75-inch rockets, are not fired at Makua.

The reservation contains 17 square kilometers (4,190 acres), with about 4.2 square kilometers (1,034 acres), suitable for maneuver and training and 7.9 square kilometers (1,944 acres) designated as impact area. The maneuver space is split into two parcels by a dominant ridgeline oriented on an east/west axis. The southern parcel is the larger of the two areas and allows more flexibility in which missions can be conducted. The northern parcel is adaptable for smaller units such as platoon and squads; it can also be used to support objectives in the southern area.

7.2 SURROUNDING LAND USES [21]

The MMR entire training area is within a Conservation District which includes both sides of the Waianae ridge line and out to Kaena Point. The area northeast of the conservation area and the Kiaau Valley located to the south are designated agricultural districts. Makua Beach is available to beach goers throughout the year and would be classified as a recreational land use.

7.3 TRAINING [22]

Live-fire training at MMR ceased in 2004 pending the completion of an Environmental Impact Statement (EIS). The Record of Decision (ROD) for this action was signed July 16, 2009.

After fully considering all aspects of the Environmental Impact Statement and extensive public input, the Army decided not to choose the EIS preferred alternative of conducting 50 Combined

[21] http://www.globalsecurity.org/military/facility/makua.htm
[22] http://www.garrison.hawaii.army.mil/MakuaEIS/index.html

Arms Live Fire Exercise (CALFEX) and 200 convoy live-fire exercises per year with minimal weapons restrictions.

Rather, the Army decided on a greatly reduced option of 32 CALFEXs and 150 convoy live-fire exercises per year without the use of tracer ammunition, TOW missiles, anti-tank (AT-4) and 2.75-caliber rockets, Javelins, the shoulder-launched multipurpose assault weapon, or Illumination munitions of any kind.

The elimination of these weapon systems greatly reduces the risk of range fires and environmental threats to endangered species and cultural sites, yet allows Hawaii based units to train locally without the costly burden of additional deployments to PTA or CONUS.

7.4 FUTURE NOISE ENVIRONMENT

7.4.1 LARGE ARMS NOISE

The principal sources of noise for future training at Makua are based on large caliber weapons firing. The worst case scenario of 50 CALFLEX was depicted for data input into the noise model. Figure 7-2 details the noise contours resulting from CALFLEX training which also depicts the propagation of sound over water.

Since there are multiple training activities occurring at any given time on Makua, all of which have the ability to generate substantial noise, it is prudent to evaluate the sum of these activities rather than all the individual parts. In effect, this provides a "worst case scenario" for all firing operations on the military reservation. Therefore, all noise contours modeled for Makua are for combined training operations unless stated otherwise. The data sheet for Makua is found in Appendix B.4.

<u>Conclusions:</u>

- For both the highest projected (50 CALFEX) and reduced (32 CALFEX) training activity, the Zone III noise contour would overlap the Makua Beach recreational area. This land use would not be recommended for the noise environment. For consideration, the hours of live-fire training at MMR would typically occur in the early morning and evening hours and less of an impact when compared to long term residential areas.

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- Public notification using available media before training exercises generating high noise levels could minimize the short-term adverse CALFLEX annoyance impact on beach goers. [23]

[23] Draft Environmental Impact State, Military training Activities at Makua Military Reservation, March 2005

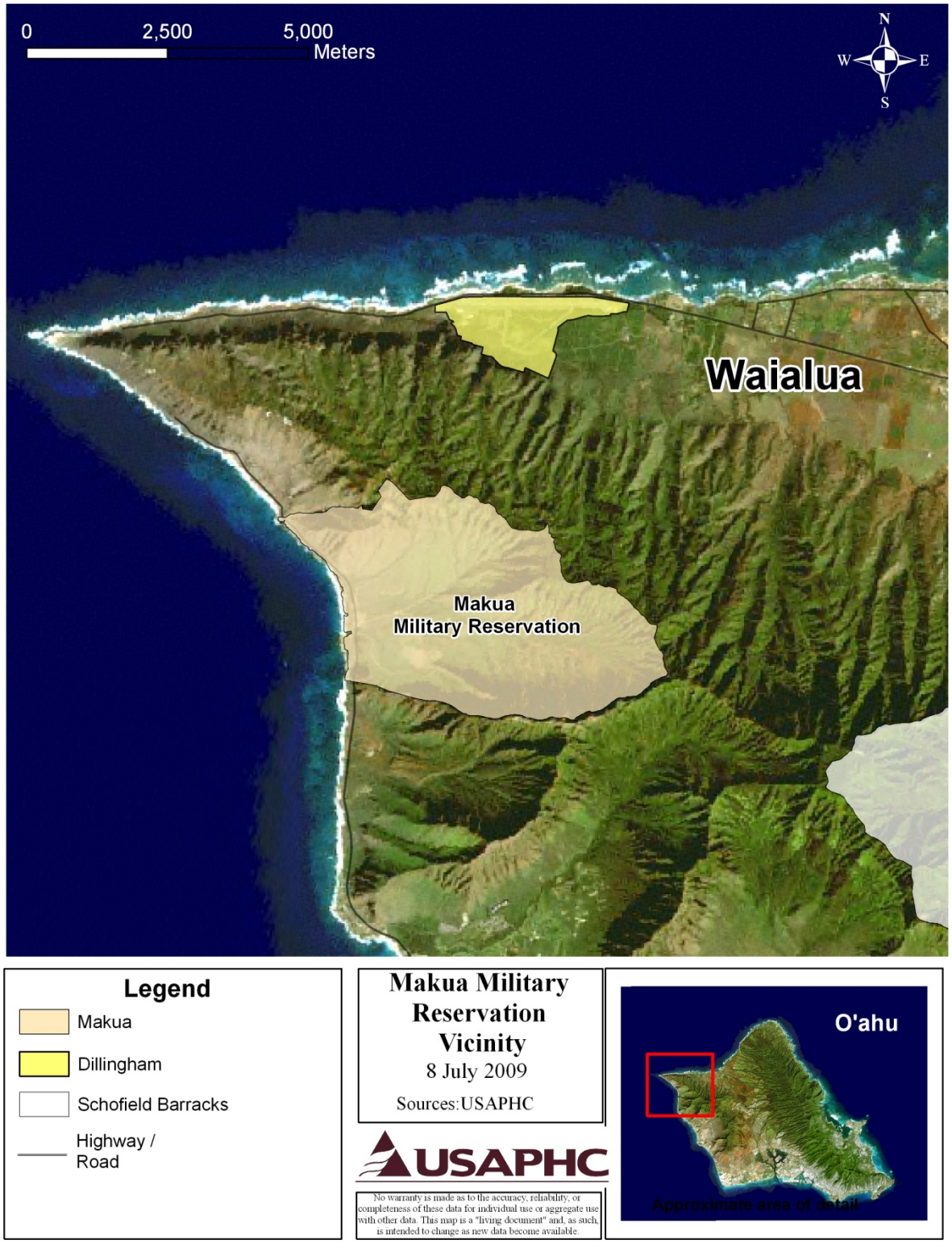

Figure 7-1 Makua Military Reservation Vicinity

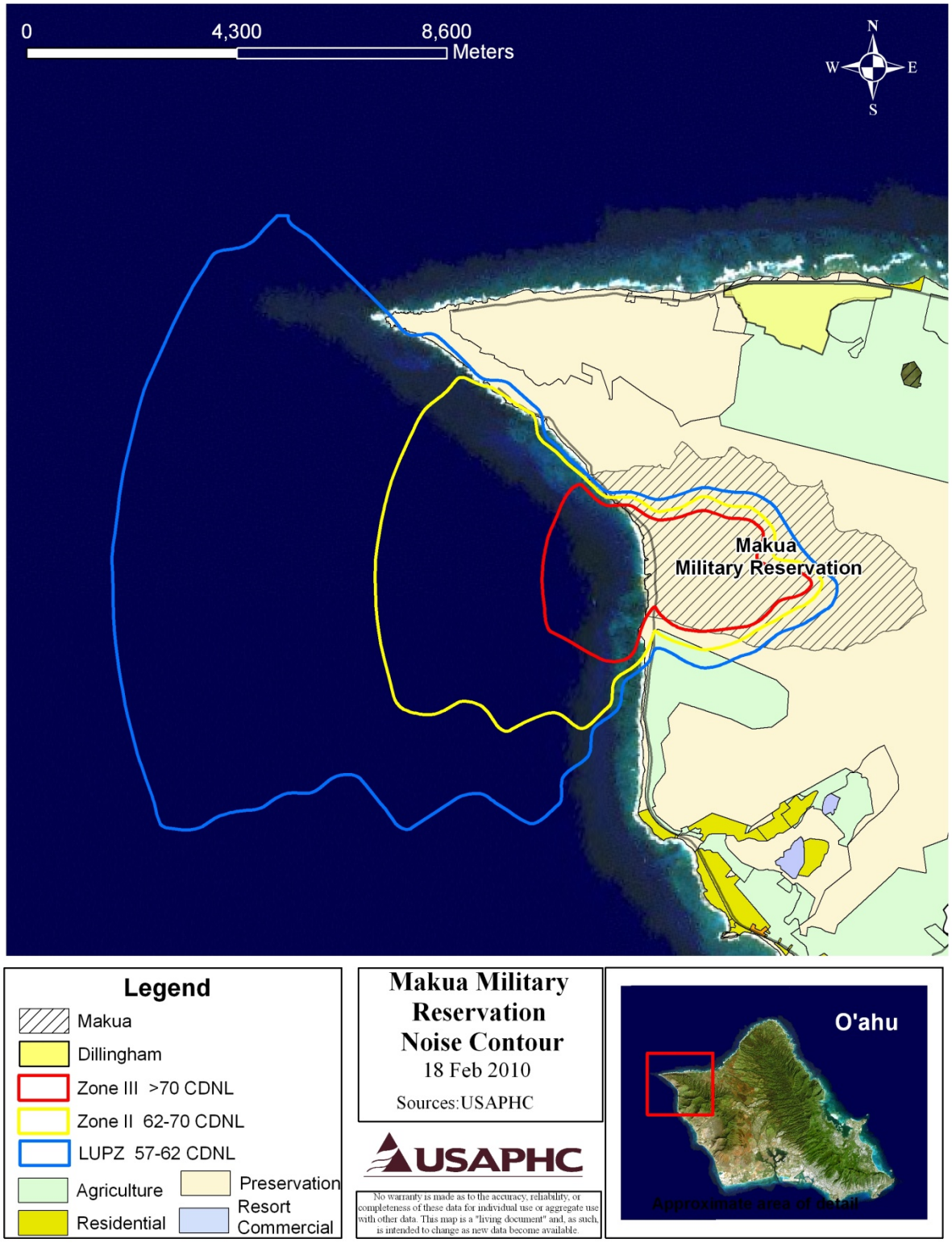

Figure 7-1 Makua Military Reservation Large Arms Noise Contour

8.0

KAHUKU TRAINING AREA

8.1 GENERAL [24]

The Kahuku Training Area (KTA) is situated on the North Shore of O`ahu on the northern end of the Koolau Mountain Range, approximately 18 miles from Schofield Barracks. The southern portion of the area lies adjacent to the Kawailoa Training Area (KLOA) and is the largest contiguous ground-maneuver training area on O`ahu. The KTA is leased by the Army from the State of Hawai`i and from private land owners. The Honolulu Engineer District of the Army Corps of Engineers negotiated the purchase of the 8,216-acre training area. The acquisition assured an important training area would always be available for military units in Hawai`i to maintain their combat readiness.

The southern (uphill) portion of KTA is characterized by rugged, densely vegetated terrain. Only the northern portion contains an area suitable for maneuver. This training area varies from rolling grass and brush-covered terrain, with some trees in the northern half to the extremely rugged area in the south. The entire area is compartmented by several gullies that are oriented south to north.

The major access into this training area is a single paved road which leads from Kamehameha Highway, State Route 83, to the former Nike Site 2. Unimproved dirt roads, hiking trails, and several designated helicopter landing zones exist throughout the training area.

8.2 SURROUNDING LAND USES [25]

Due to heavy tourism, local residents have also set up a number of novelty shops, boutiques and markets that showcase the natural produce from Kahuku's fertile lands. These specialties offer people different Hawai`ian delicacies and harvests. In the town of Kahuku, local trade is continuously seeing prosperity, due to its booming tourism industry.

The land uses surrounding KTA is dedicated agriculture (sugarcane), preservation (Koolau Mountain Range), and federal to the south (Kawailoa Training Area (KLOA)). The closest residential area is Sunset Beach due north-west on the shoreline approximately is 80 meters from

[24] http://www.globalsecurity.org/military/facility/kahuku.htm
[25] http://www.mcbh.usmc.mil/g3/g3opkah.htm

the KTA boundary (see Figure 8-1) and the town of Kahuku which lies approximately 1500 meters from KTA training area.

8.3 TRAINING [26]

The KTA is used for tactical maneuver training, including mountain and jungle warfare with fixed and rotary wing air support training. The terrain is excellent for mountain and jungle warfare training. Blank ammunition (5.56 mm rifle and 7.62 mm machine gun) and pyrotechnics may be used. Although live fire is authorized, live fire operations have not been conducted in KTA since 1964.

The KTA is capable of accommodating varying scenarios supporting infantry battalion Army Training and Evaluation Program (ARTEP) missions. Much of the terrain is rugged and ill suited for large-scale field exercises. Three infantry battalion missions ideally require many more contiguous acres than are available in KTA in order to fully incorporate all combat assets that should be exercised in the execution of this mission. Table 8-1 and Figure 8-2 detail the training and locations at KTA.

Training Area	Type
A1/A2/A3 B1/B2 C1/C2 D1/D2	**MANEUVER/TRAINING AREA, LIGHT FORCES -** Space for ground and air combat forces to practice movements and tactics as specified in the unit's Army Training and Evaluation Program (ARTEP). Different type units may work in support of one another (combined arms), or a unit may operate on its own to practice a specific set of ARTEP tasks. The "light" designation refers to areas where maneuver may be restricted for some reason to only small units or units having only wheeled vehicles. "Light" maneuver/training areas are not typically used by "heavy" forces other than assembly areas where movement is restricted to roads or trails.

Table 8-1 Kahuku Training Area Description

[26] http://www.globalsecurity.org/military/facility/kahuku.htm

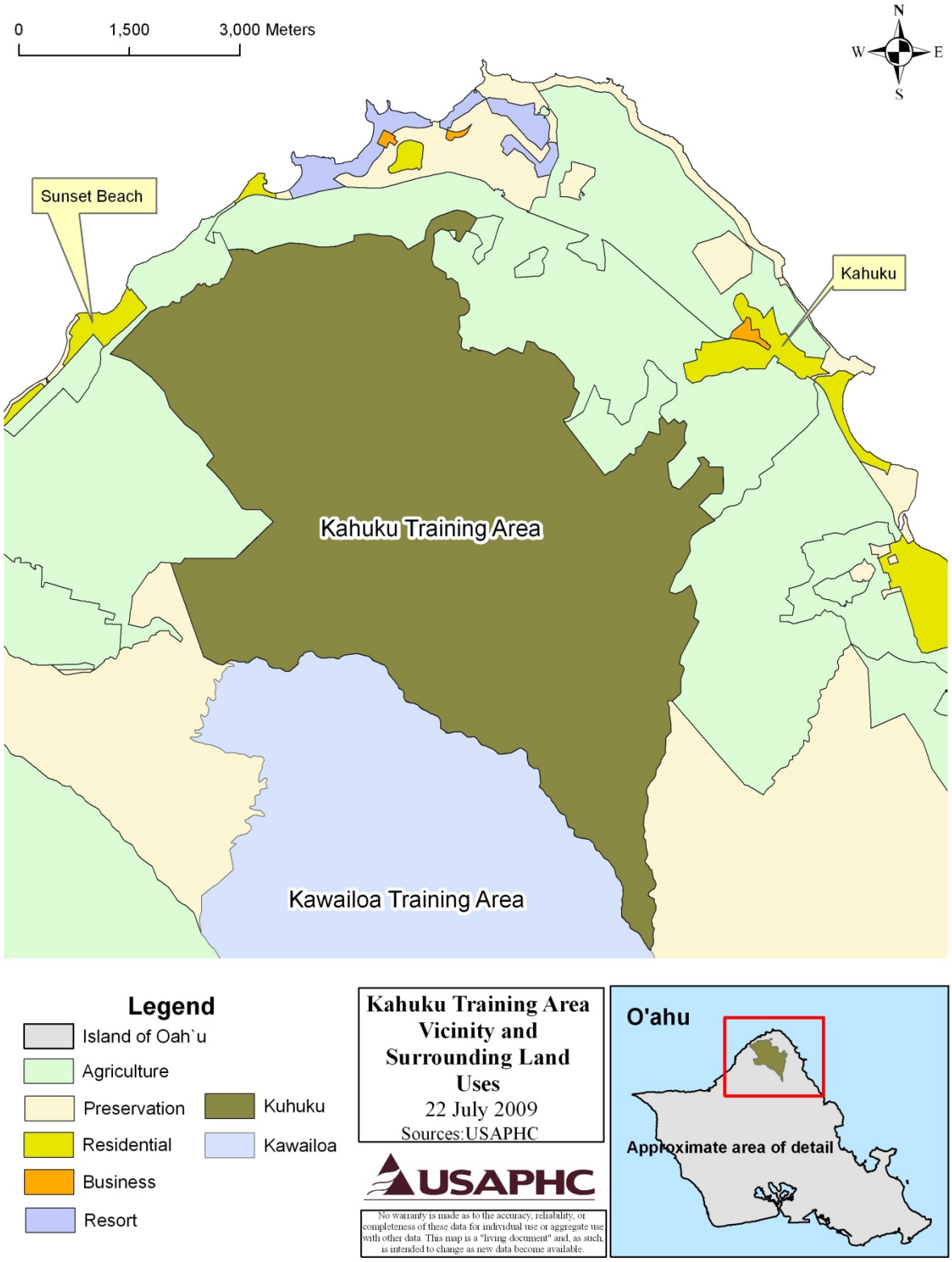

Figure 8-1 Kahuku Training Area Vicinity Map and Surrounding Land Uses

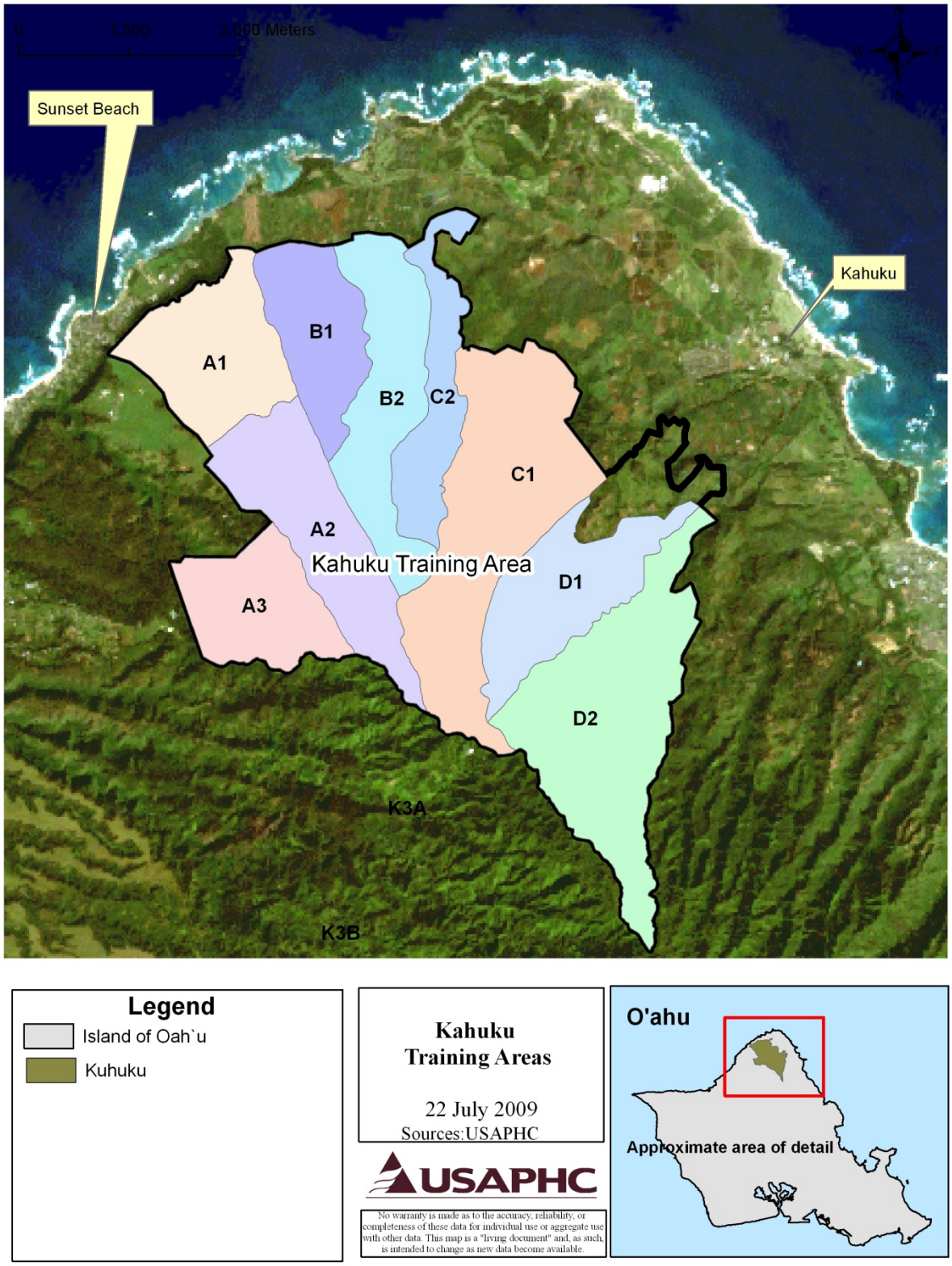

Figure 8-2 Kahuku Training Areas

8.4 CURRENT NOISE ENVIRONMENT

The principal sources of noise on KTA are generated through small arms blank firing and aircraft (rotary wing) noise.

8.4.1 SMALL ARMS NOISE

To generate contours using SARNAM, specific firing point and target point locations must be entered into the computer. Training at KTA consists of blank rounds (7.62 mm blank and 5.56 mm blank) where there are no set firing point or target point locations; firing can occur at multiple locations and in multiple directions during ARTEP missions. Therefore, noise contours for this mobile activity cannot be modeled using SARNAM.

However, by looking at the predicted peak levels for the loudest weapon used (7.62 mm blank), provided in Table 8-2, we can see that noise approaching Zone II levels [PK15(met) 87 dB] would extend out approximately 800 meters from the source. By subtracting the 500 meter Schofield range regulation standoff distance, it could be inferred that 300 meters off post would be the furthest extent that noise from small arms firing could approach Zone II limits. However, due to the mountainous terrain surrounding the majority of the installation, levels approaching Zone II limits for rifle firing probably would not extend the full 300 meters beyond the boundary. Also from Chapter 5, Table 5-3 **(**Insertion Loss through a Growth of Medium Dense Woods) indicates additional noise attenuation through such terrain as KTA.

	Predicted Level, dBP Azimuth		
Distance, meters	**0°**	**90°**	**180°**
50		113-123	106-116
100	109-119	106-116	101-111
200	103-113	100-110	94-104
400	92-102	89-99	85-95
800	**84-94**	**81-91**	**77-87**
1600	75-85	72-82	69-79

TABLE 8-2 Predicted Peak for M60 Blank (7.62 mm)

8.4.2 AIRCRAFT NOISE

Aircraft noise is also very common at military installations now that the use of helicopters has become so important in modern warfare, and given the fact that even the smallest installations can employ them (since they do not need space for a runway). So, between classic propeller, jet, and rotary aircraft, the possibilities for aircraft noise complaints are growing.

But, as stated before, the ADNL is just an average; maximum levels are often a good predictor of complaint potential. Thus, the tables below give the expected maximum levels for the most common types of military aircraft (Table 8-3), and the percentage of the population that is likely

to be annoyed by particular maximum levels (Table 8-4). Using these two tables can give a rough idea of whether a complaint is likely given specific training parameters.

Slant Distance (Feet)	Maximum Sound Level by Aircraft Type (dBA)					
	C-130H	C-17	AH-64	CH-47D	OH-58D	UH-60A
200	100	108	92	98	89	91
500	92	98	84	89	81	83
1,000	85	89	77	83	74	76
2,000	77	80	70	77	67	69
5,000	66	66	60	67	56	58
10,000	57	57	50	59	47	48

Table 8-3 Maximum A-Weighted Sound Levels of Common Military Aircraft

Maximum Level (dBA)	Percentage Highly Annoyed
70	5%
75	13%
80	20%
85	28%
90	35%

Table 8-4 Percentage of the Population Likely to be Highly Annoyed by Aircraft Noise
(Rylander 1974)

8.5 AIRCRAFT NOISE ABATEMENT

To abate aircraft noise impacts, pilots are trained to avoid unnecessary over flight of populated areas as well as single houses. In order to gain public acceptance, all pilots are trained to be sensitive to the concerns of the surrounding communities. Figure 8-3 on the next page indicates the no fly zones around KTA.

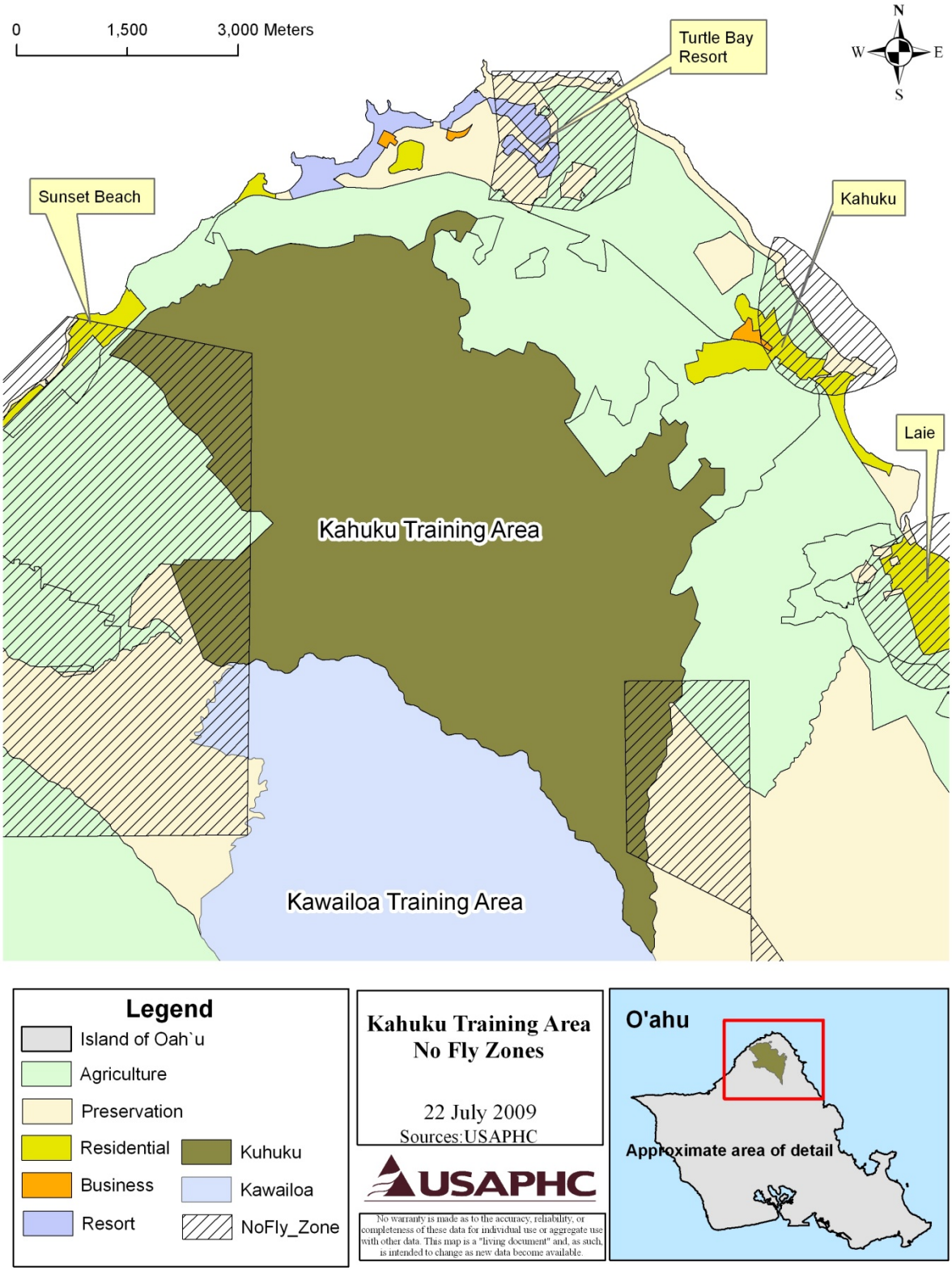

Figure 8-3 Kahuku Training Area No Fly Zones

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9.0

KAWAILOA TRAINING AREA

9.1 GENERAL

Kawailoa Training Area (KLOA) consists of 94.5 square kilometers (23,348 acres) of leased land on central O`ahu on the slopes of the Koolau Mountain range (see Figure 9-1). KLOA is situated in some of the most rugged terrain in Hawai`i. Very deep ravines, dense vegetation, and tropical rain forest characterize the terrain. Access is very limited, although there is an unimproved roadway along the western boundary of the area that transverses a small relatively flat and clear area. Only 21.5 square kilometers (5,310 acres) of the training area are actually suitable for maneuver training activities. The remaining 73 square kilometers (18,038 acres) are considered unsuitable for maneuver training activities due to the steep slopes in excess of 20 percent. The KLOA is bounded by the ridgeline of the Koolau Mountains to the east, Kahuku Training Area (KTA) to the north and Schofield Barracks East Range (SBER) to the south.

The majority of KLOA is located in the Waialua District of O`ahu. The southern portion of KLOA falls within the Wahiawa District.

9.2 SURROUNDING LAND USES

The land uses surrounding KLOA is dedicated agriculture, preservation, and federal (Kahuku Training Area bordering north and Schofield Barracks East Range bordering south). The closest residential area is Wahiawa due south west approximately 300 meters from the KLOA boundary (see Figure 9-1).

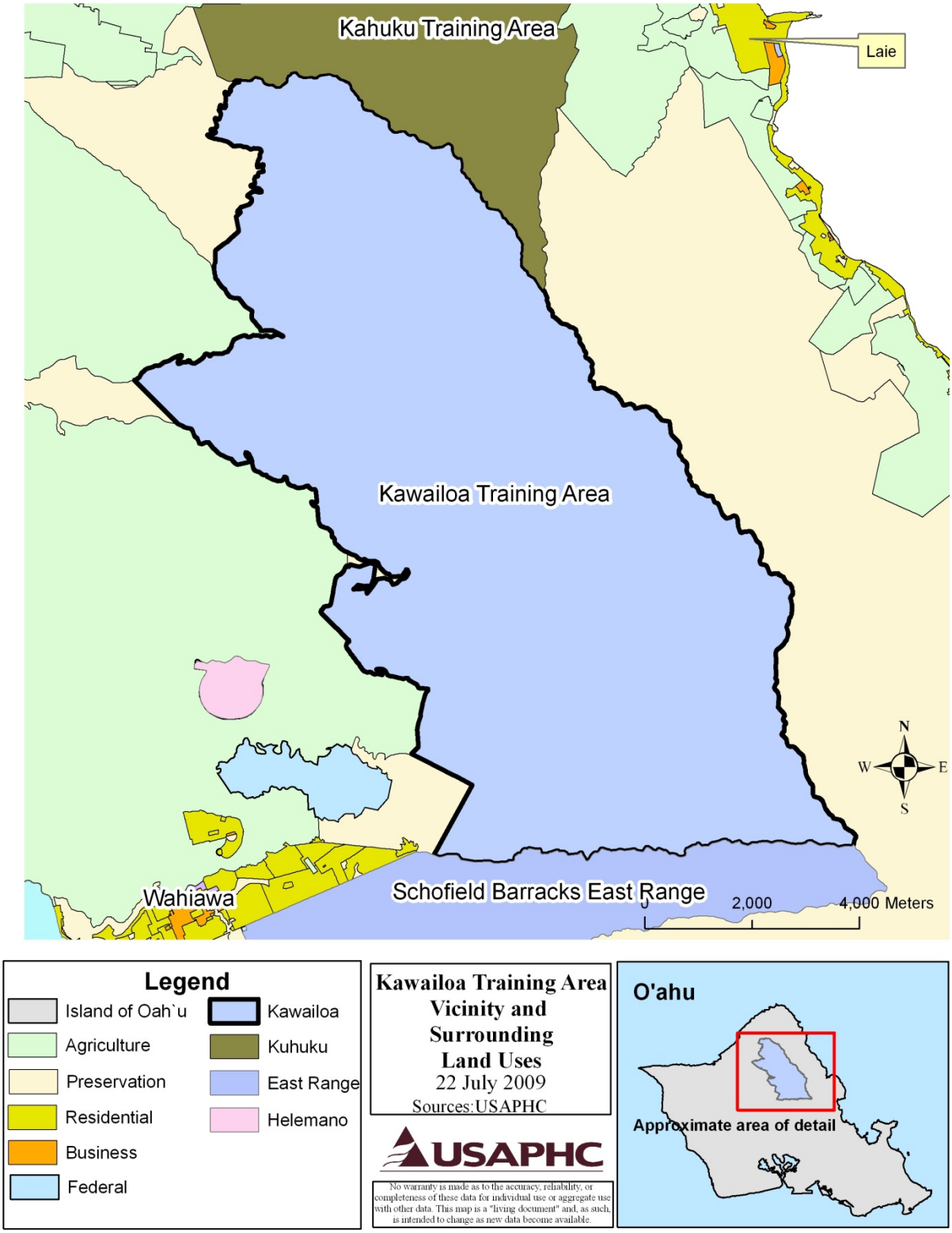

Figure 9-1 Kawailoa Training Area Vicinity Map and Surrounding Land Uses

9.3 TRAINING

KLOA is considered excellent for mountain and jungle warfare training because of its ravines and dense vegetation. In areas with a slope of 20 percent or more, troop deployment is typically limited to single file, small unit movements on ridgelines.

KLOA is used primarily for small infantry unit maneuver and helicopter training. Nap of the earth (NOE) and night vision goggle (NVG) helicopter training is common. Small unit infantry maneuver operations via helicopter insertion are also practiced. Below lists the type of training at each training area at KTA (Table 9-1). Only blank ammunition up to .50 caliber is permitted; no pyrotechnics or live fire is allowed.

Training Area	Type
K1A/K1B K2A/K2B/K2C K3A/K3B	**MANEUVER/TRAINING AREA, LIGHT FORCES -** Space for ground and air combat forces to practice movements and tactics as specified in the unit's Army Training and Evaluation Program (ARTEP). Different type units may work in support of one another (combined arms), or a unit may operate on its own to practice a specific set of ARTEP tasks. The "light" designation refers to areas where maneuver may be restricted for some reason to only small units or units having only wheeled vehicles. "Light" maneuver/training areas are not typically used by "heavy" forces other than assembly areas where movement is restricted to roads or trails.

Table 9-1 Kawailoa Training Area Description

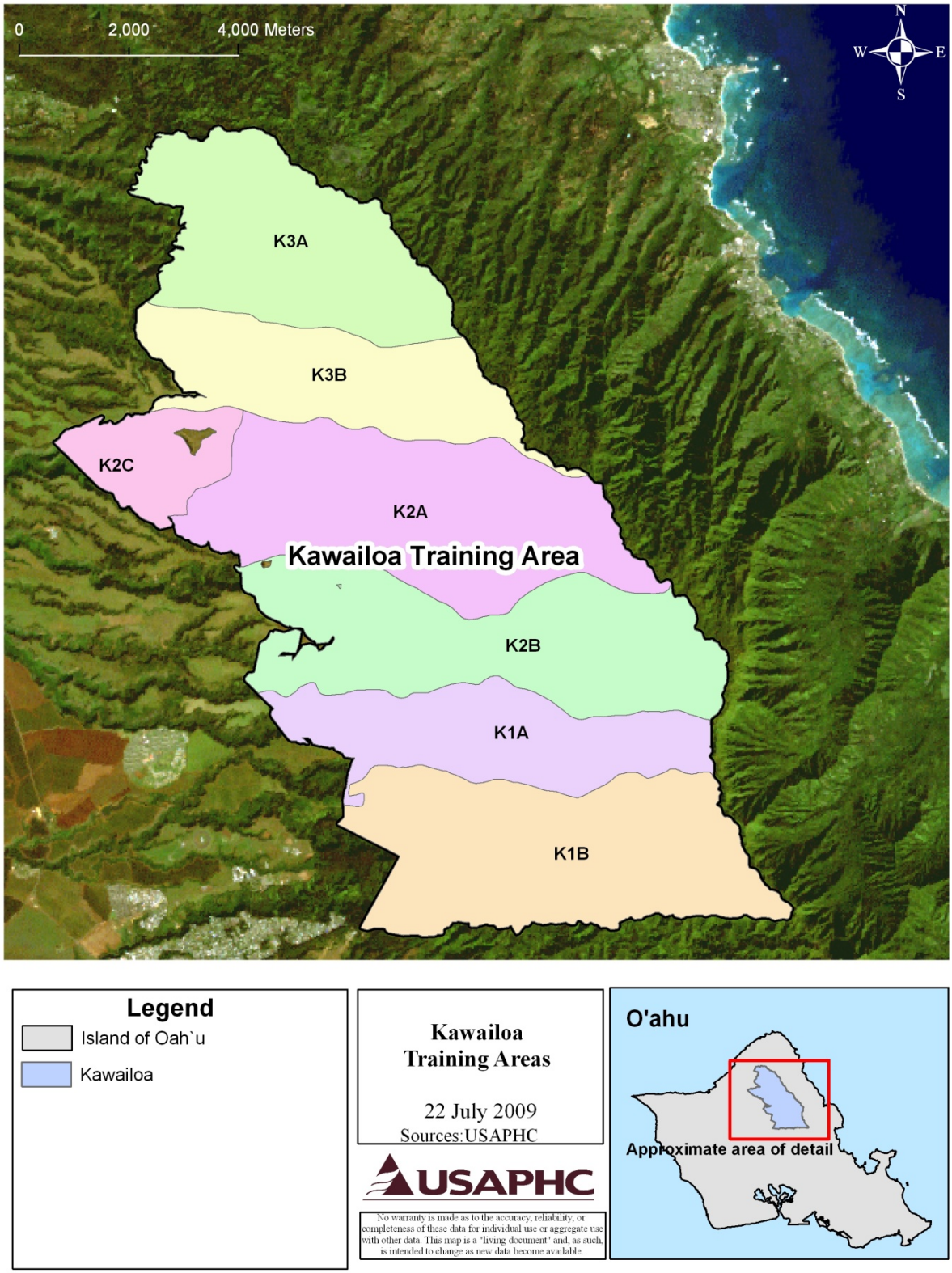

Figure 9-2 Kawailoa Training Areas

9.4 CURRENT NOISE ENVIRONMENT

The principal sources of noise on KLOA are generated through small arms blank firing and aircraft (rotary wing) noise.

9.4.1 SMALL ARMS NOISE

To generate contours using SARNAM, specific firing point and target point locations must be entered into the computer. Training at SBER consists of blank rounds (up to .50 cal) where there are no set firing point or target point locations; firing can occur at multiple locations and in multiple directions during ARTEP missions. Therefore, noise contours for this mobile activity cannot be modeled using SARNAM.

However, by looking at the predicted peak levels for the loudest weapon used (.50 cal blank) provided in Table 9-2, we can see that noise approaching Zone II levels [PK15(met) 87 dB] would extend out approximately 800 meters from the source. By subtracting the 500 meter Schofield range regulation standoff distance, it could be inferred that 300 meters off post would be the furthest extent that noise from small arms firing could approach Zone II limits. The land uses within 300 meters of the boundary include agriculture, preservation, and federal land (Kahuku Training Area bordering north and Schofield Barracks East Range bordering south).

	Predicted Level, dBP Azimuth		
Distance, meters	**0°**	**90°**	**180°**
50	122-132	118-128	116-126
100	116-126	110-120	111-121
200	109-119	103-113	104-114
400	97-107	92-102	91-101
800	**89-99**	**84-94**	**84-94**
1600	81-91	75-85	75-85

TABLE 9-2 Predicted Peak for MG 50 Cal Blank

9.4.2 AIRCRAFT NOISE

The rotary wing aircraft training at KLOA would also apply to training noise levels at KTA. See Section for 8.4.2 for more detail.

9.5 AIRCRAFT NOISE ABATEMENT

To abate aircraft noise, pilots are trained to avoid unnecessary over flight of populated areas as well as single houses. In order to gain public acceptance, all pilots are trained to be sensitive to the concerns of the surrounding communities. Figure 9-3 on the next page indicates the no fly zones around KLOA.

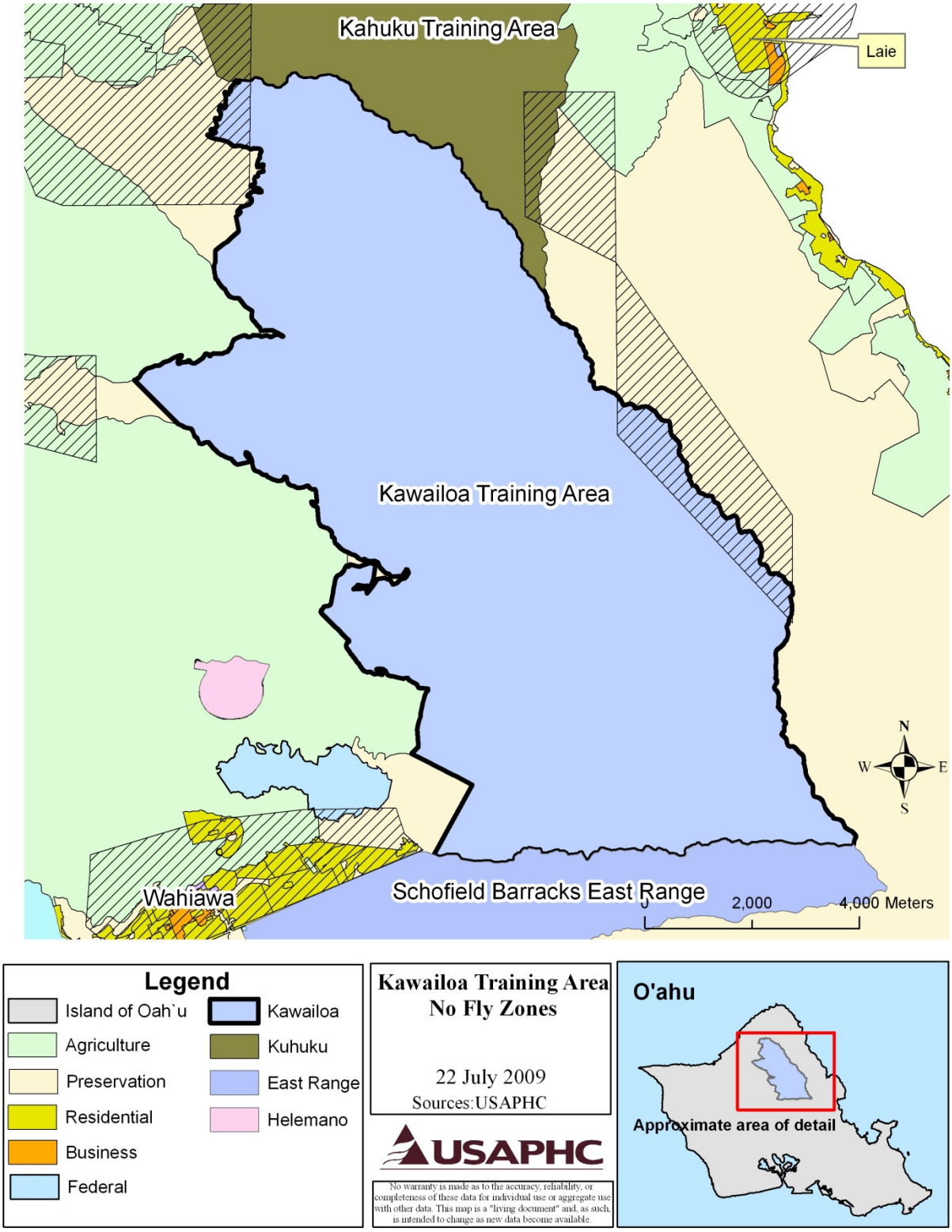

Figure 9-3 Kawailoa Training Area No Fly Zones

10.0
DILLINGHAM MILITARY RESERVATION

10.1 GENERAL[27]

Dillingham Millitary Reservation (DMR) is located in the City and County of Honolulu on the North Shore of O'ahu near the town of Waialu (see Figure 10-1) near Kaena Point. The Hawai'i Department of Transportation (DOT) leases 272 acres (Dillingham Airfield) of the 650 acre DMR and operates the single 5,000-foot runway primarily for commercial glider and sky diving operations.[28] Dillingham Airfield is also suitable for fixed wing and helicopter operations. The current U.S. Army lease is 25-years. The DMR borders the airfield and is used for platoon and squad sized maneuver training. The terms of the lease limit civil operations to the daytime hours (sunrise to sunset), and reserve evening and nighttime hours for military operations. With prior notification to the Hawai`i DOT, the Army can close Dillingham Airfield for daytime military training activities.

Non-military activities are permitted on Dillingham Airfield. These uses include public recreation, utility right-of-way, and agricultural access. Identified public recreational uses of the reservation include hiking, hunting, mountain biking, and the use of dirt bikes.

10.2 SURROUNDING LAND USES

Figure 10-2 indicates that the land uses surrounding DMR is dedicated agriculture, preservation, and federal. The closest residential area is located due east of Dillingham Airfield near the Mokuleia Beach Park off route 930 (Farrington Highway) and Laau / Paina Place.

[27] http://en.wikipedia.org/wiki/Dillingham_Airfield
[28] http://hawaii.gov/hnl/airport-information/dillingham-air-field

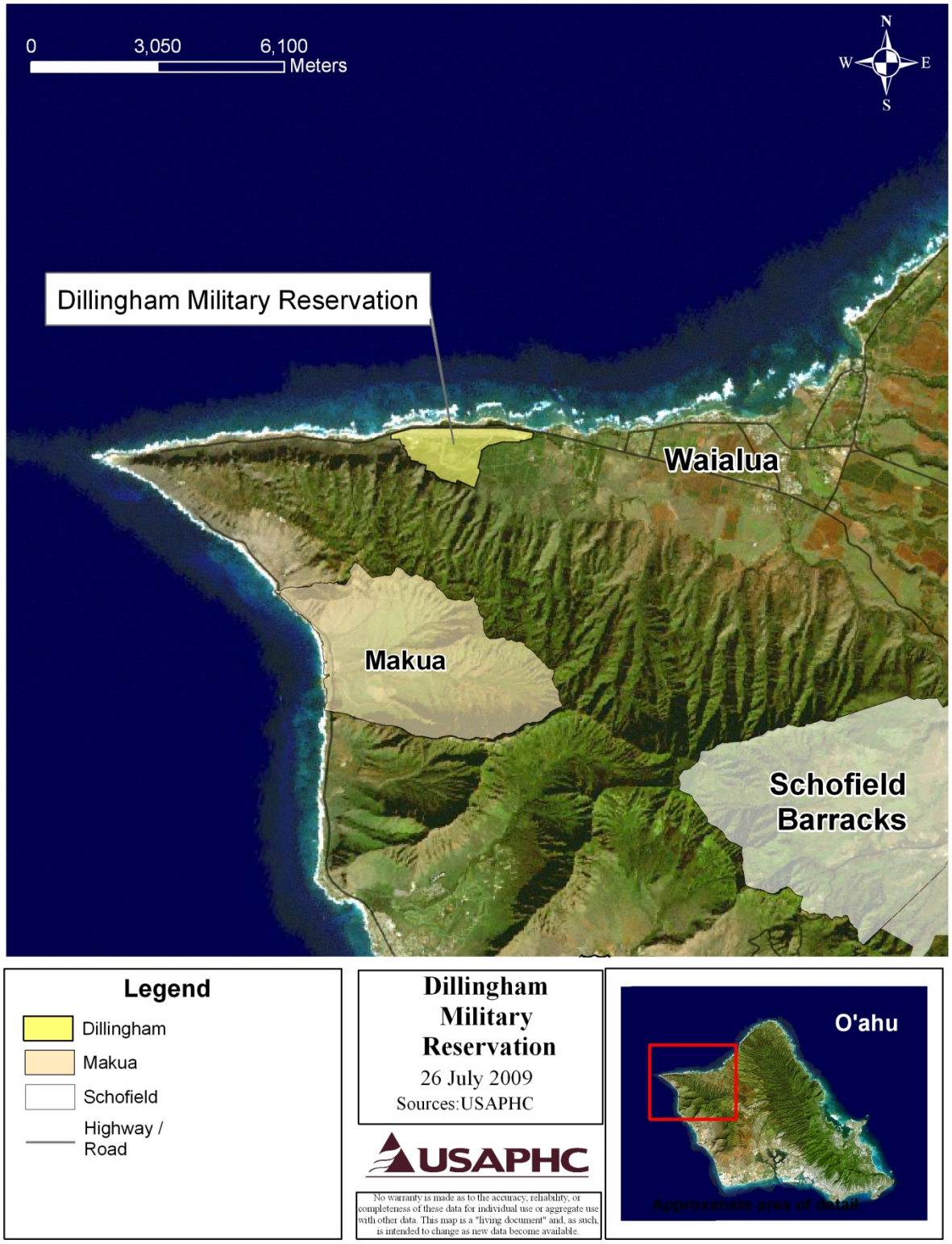

Figure 10-1 Dillingham Military Reservation

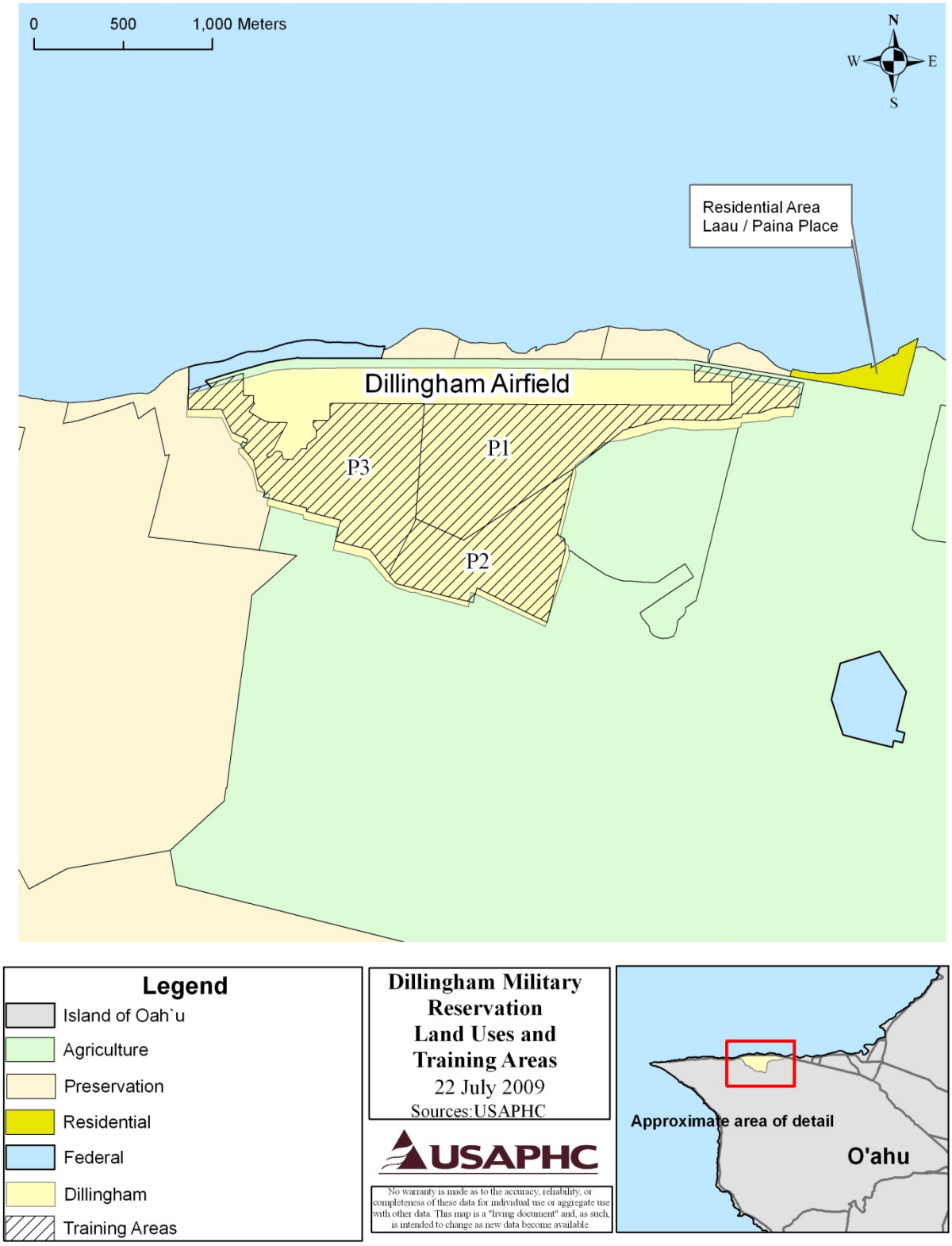

Figure 10-2 Dillingham Military Reservation Surrounding Land Uses and Training Areas

10.3 TRAINING

U.S. Army training is restricted to the use of blanks (5.56mm blank) and is prohibited on the runway. Maneuver training is not permitted on the portion of the airfield that is leased to the State of Hawai`i unless prior state approval is coordinated.

Training Area	Type
P1 P2 P3	**MANEUVER/TRAINING AREA, LIGHT FORCES -** Space for ground and air combat forces to practice movements and tactics as specified in the unit's Army Training and Evaluation Program (ARTEP). Different type units may work in support of one another (combined arms), or a unit may operate on its own to practice a specific set of ARTEP tasks. The "light" designation refers to areas where maneuver may be restricted for some reason to only small units or units having only wheeled vehicles. "Light" maneuver/training areas are not typically used by "heavy" forces other than assembly areas where movement is restricted to roads or trails.

Table 10-1 Dillingham Military Reservation Training Area Description

10.4 CURRENT NOISE ENVIRONMENT

The principal sources of noise on DMR are generated through small arms blank firing and aircraft (rotary wing) noise. Military operations consist largely of night operations for night vision device training.

10.4.1 SMALL ARMS NOISE

To generate contours using SARNAM, specific firing point and target point locations must be entered into the computer. Training at DMR consists of blank rounds (5.56mm blank) where there are no set firing point or target point locations; firing can occur at multiple locations and in multiple directions. Therefore, noise contours for this mobile activity cannot be modeled using SARNAM.

However, by looking at the predicted peak levels for the loudest weapon used (5.56 mm blank) provided in Table 10-2, we can see that noise approaching Zone II levels [PK15(met) 87 dB] would extend out approximately 200 meters from the source. By subtracting the 500 meter Schofield Barrack range regulation standoff distance, Zone II levels would remain entirely on DMR property.

	Predicted Level, dBP Azimuth		
Distance, meters	**0°**	**90°**	**180°**
50	94-104	**92-102**	92-102
100	87-97	86-96	87-97
200	**80-90**	**79-89**	**80-90**
400	69-79	68-78	69-79
800	60-70	59-69	60-70
1600	51-61	49-59	50-60

TABLE 10-2 Predicted Peak for Rifle M-16 Blank

10.4.2 AIRCRAFT NOISE

Military operations consist largely of night operations for night vision device training. See Section for 8.4.2 for more detail.

10.5 AIRCRAFT NOISE ABATEMENT [29]

To abate aircraft noise impacts, pilots are trained to avoid unnecessary over flight of populated areas as well as single houses. In order to gain public acceptance, all pilots are trained to be sensitive to the concerns of the surrounding communities. Figure 10-3 on the next page indicates the closest "no fly" zone would be over the town of Waialu, approximately 4500 meters east of Dillingham Airfield.

USAG-HI Installation IASC flight restriction require pilots a minimum altitude of 3000 feet mean sea level (MSL) over noise sensitive areas. If weather conditions will not permit flight at 3000 feet MSL, pilots are required to circumnavigate the noise sensitive areas.

[29] USAG-HI Installation IASC SOP (Draft 22 August 08)

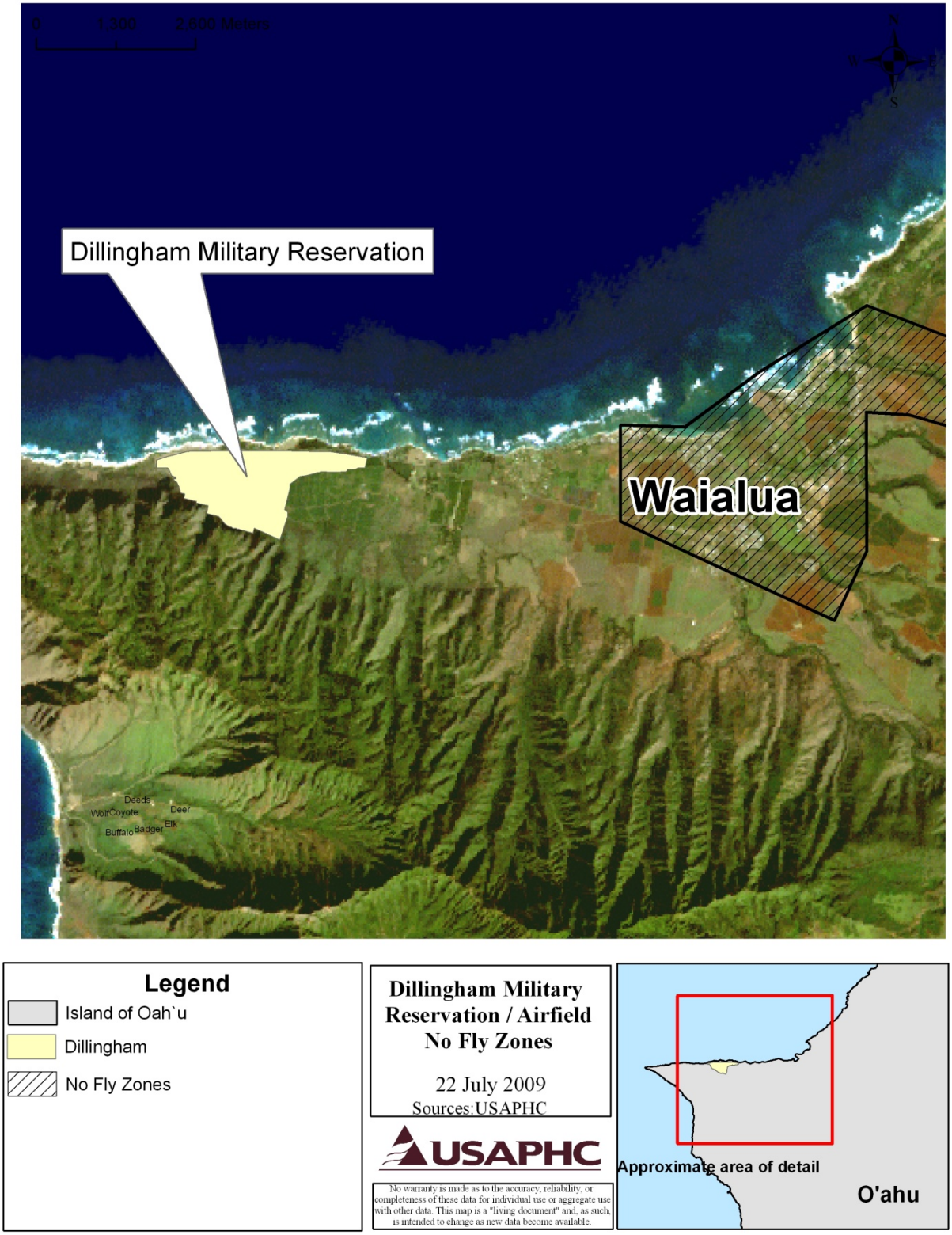

Figure 10-3 Dillingham Military Reservation / Airfield No Fly Zones

11.0

POHAKULOA TRAINING AREA

11.1 GENERAL [30]

Pohakuloa Training Area (PTA) is a unique and vast operational training area located in the plateau area known as the "Saddle" between Mauna Kea and Mauna Loa on the Island of Hawai`i (Figure 11-1). Accessed via the Saddle Road (State Highway 200), it is approximately 40 miles from the city of Hilo on the eastern coast of the island and 40 miles from the town of Kailua Kona located on the western plane. PTA consists of 108,863 acres, of which 24,048 are leased by the Army from the State of Hawai`i. The remaining land is ceded and includes the impact and range areas and a portion of the west maneuver area. The leased areas include the northern maneuver areas and the support complex. Within 4,000 feet, directly west of the built-up area, is Bradshaw Army Airfield, a limited use airfield with a 90 by 3,696-foot paved runway at an elevation of 6,190 feet above MSL.

For the most part, the entire land area is rugged, barren lava field which provides unique operational training conditions and an adequate area for field exercise of Brigade size units in the use of tactical weapons. The terrain includes numerous volcanic vents and cinder cones up to 400 feet high, lava dikes and ridges and gently sloping areas. Except for some small intermittent pools in the extreme northeast corner of the reservation, there are no water areas in PTA. There are several springs along the slope of Mauna Kea north of the present cantonment area that provide a limited source of potable water for the installation.

[30] http://www.globalsecurity.org/military/facility/pohakuloa.htm

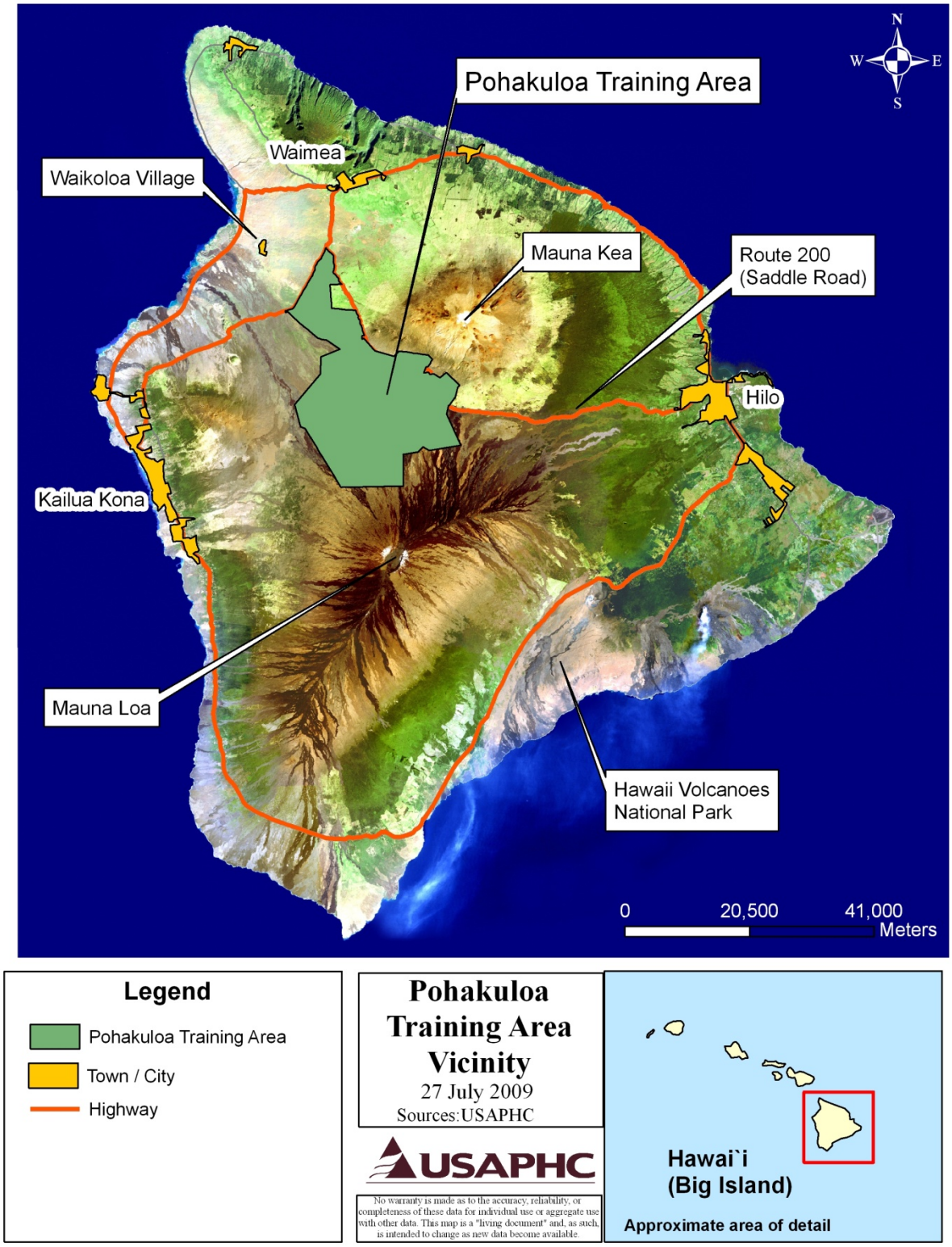

Figure 11-1 Pohakuloa Training Area Vicinity

11.2 SURROUNDING LAND USES [31]

PTA and much of the surrounding land is designated a conservation district. The area overlaps both state and privately-owned land which includes Mauna Kea, Mauna Loa, and the central saddle area. The majority of land surrounding PTA is not used with the exception of lower elevations for agricultural and cattle grazing. In addition, a small amount of land to the north is used for sugar cane. The closest residentially zoned area is Waikoloa Village approximately 6 km northwest from the PTA boundary (Figure 11-2).

[31] http://www.mcbh.usmc.mil/g3/g3oppta.htm

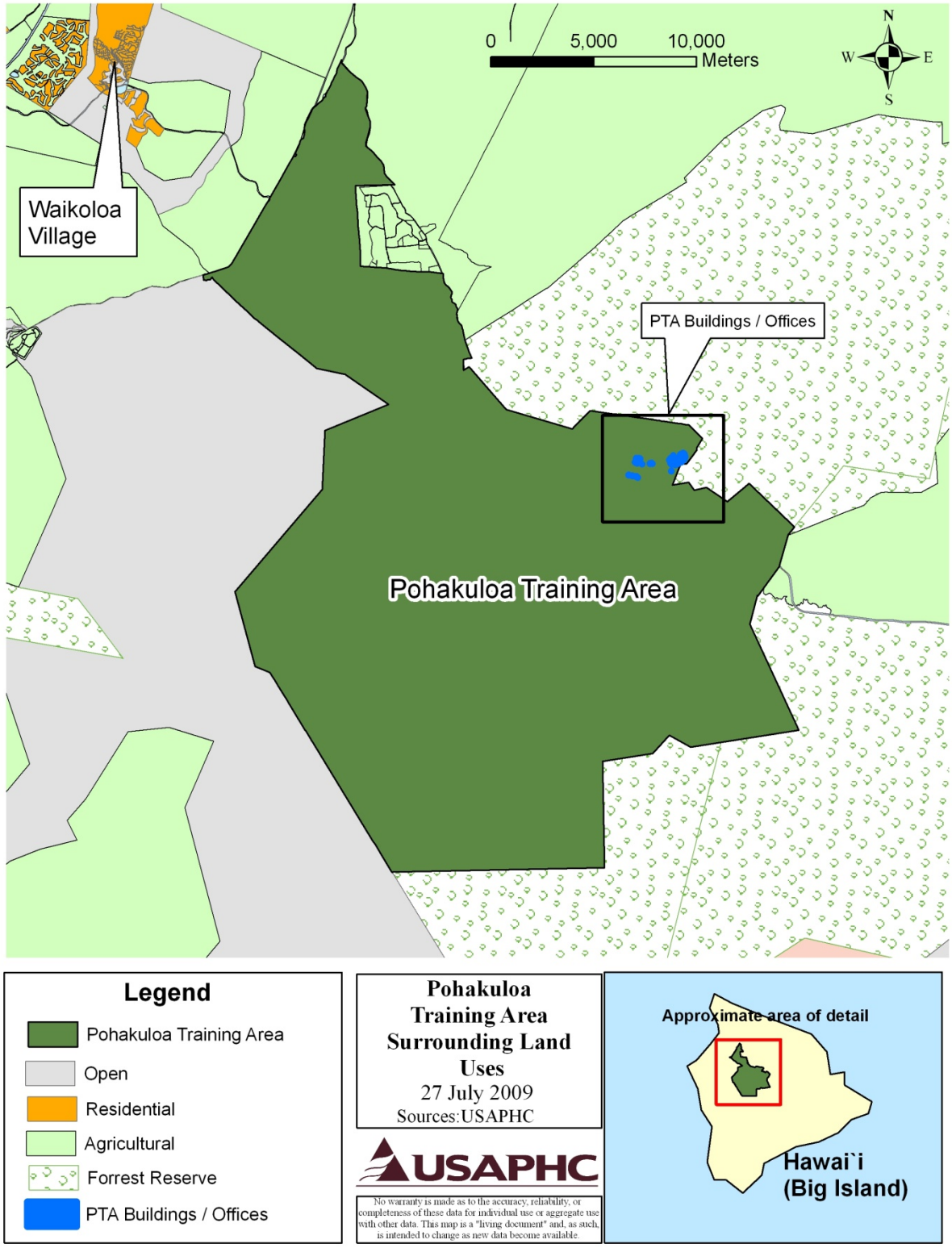

Figure 11-2 Pohakuloa Training Area Surrounding Land Uses

11.3 TRAINING [32]

As the largest training area in Hawai`i, PTA can be used to accomplish nearly all of the varying types of training required by the military forces. PTA has a 51,000 acre impact area which is over 10 times the size of the impact area at Schofield Barracks. There are approximately 32,000 acres free of recent lava flows which are considered fully usable for large maneuver exercises. The impact area is surrounded on the north by several ranges and designated firing points for artillery. A support area of 600 acres containing logistic and administrative facilities plus quarters for approximately 2,000 troops is located to the north at the base of Mauna Kea. Figure 11-3 and Table 11-1 indicate the locations and types of firing ranges currently utilized at PTA.

Training Area (Range)	Type
1	SQ BTL AUTO
1-Attack	SQ BTL AUTO
2	CBT PISTOL CRS
3	GRENADE LCHR RANGE
6	BASIC 10/25 RANGE
8	AUTO MPMG RANGE
8A	LAW RANGE
8B	40MM GR MG QUAL
8S	SNIPER RANGE
9	LIGHT DEMO RANGE
10	IN PLT BTL AUTO
11L	ANTIARM TKG/LIV
11T	ANTIARM TKG/LV
12	AUTO MPMG RANGE
13 and 13A	FA DIRECT RANGE
14	NS SMALL ARMS RANGE
17	AERIEL GUNNARY RANGE
18	ROTARY WING LAND PAD UNPAVED

TABLE 11-1 Pohakuloa Training Area Range Types

[32] http://www.globalsecurity.org/military/facility/pohakuloa.htm

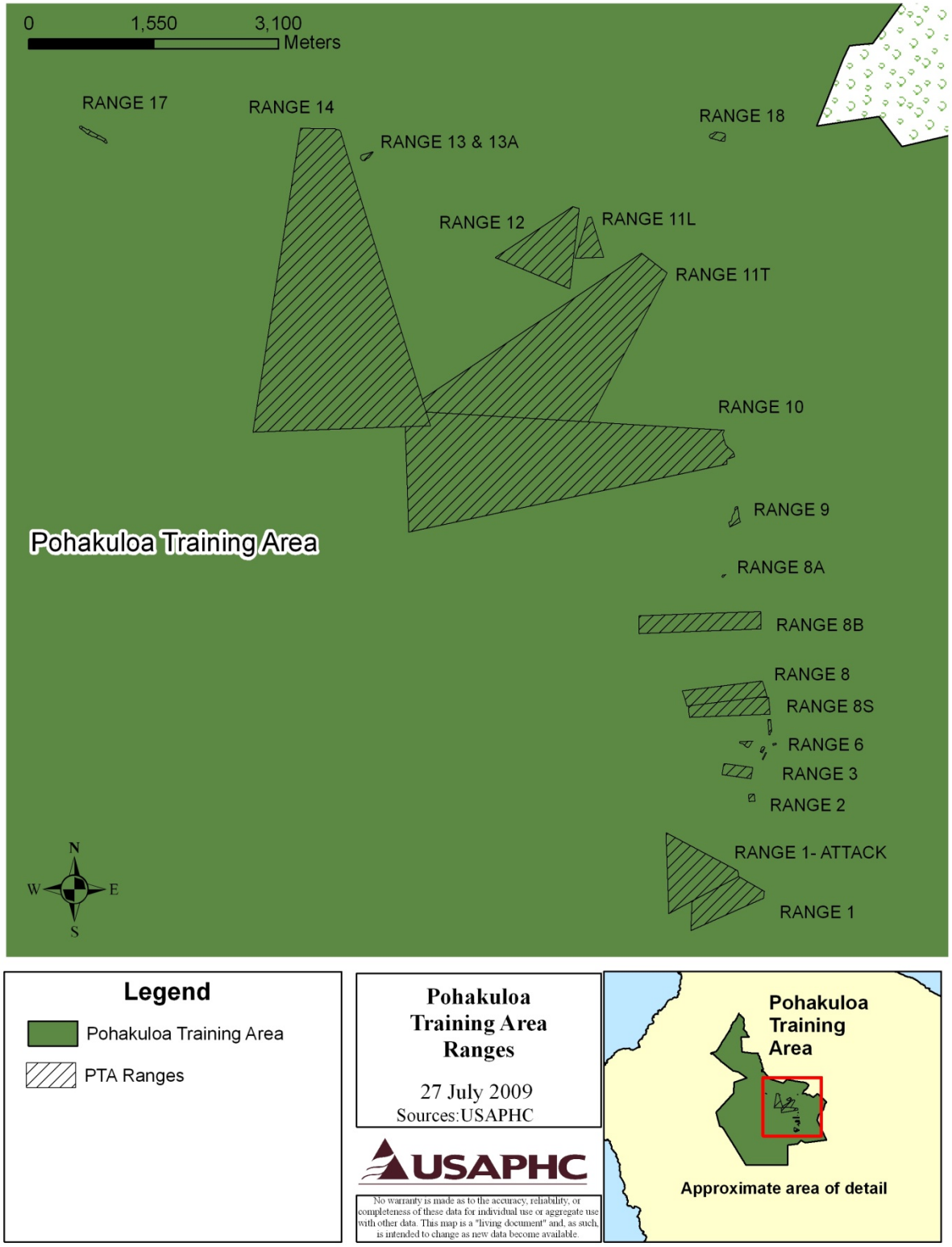

Figure 11- 3 Pohakuloa Training Area Ranges

11.4 CURRENT NOISE ENVIRONMENT

PTA is used for year round live fire exercises by all branches of the U.S. Military. The principal sources of noise on PTA are generated through small arms and large caliber weapons firing.

Since there are multiple training activities occurring at any given time on PTA, all of which have the ability to generate substantial noise, it is prudent to evaluate the sum of these activities rather than all the individual parts. In effect, this provides a "worst case scenario" for all firing operations on the installation. Therefore, all noise contours modeled for PTA are for combined training operations unless stated otherwise. The noise contours generated consisted of training data provided by PTA from 30 September 2007 – 01 October 2008.

11.4.1 SMALL ARMS NOISE

A brief discussion of small arms firing in chapter two states that the "impact of a small arms range (i.e. live-fire) is relatively localized and thus, under most weather conditions, once a receiver is 1,000 meters from the range (behind the firing line), levels should not be high enough to annoy people". The small arms ranges on PTA are located to the interior of the installation, where noise from firing has a negligible effect on and off post.

The combined peak level noise contours for small arms are illustrated in Figure 11-4. As mentioned above, the majority of the noise contours remain within the PTA boundary. Only a small section of Zone II exists off post in acceptable forest reserve land uses. The computer modeling program (SARNAM) cannot take into account reflection or absorption of terrain, so the actual levels existing beyond the installation boundary may well be less than 87 dB PK15(met) due to the mountainous terrain surrounding the majority of the installation.

<u>Conclusions:</u>

- The Zone III noise contours are contained within the installation boundary and do not overlap any noise sensitive areas on post.
- The Zone II noise contour exists off post in a small area of forest reserve land and is acceptable for the noise environment. There are no incompatible land uses on or off post within the Zone II noise contour.

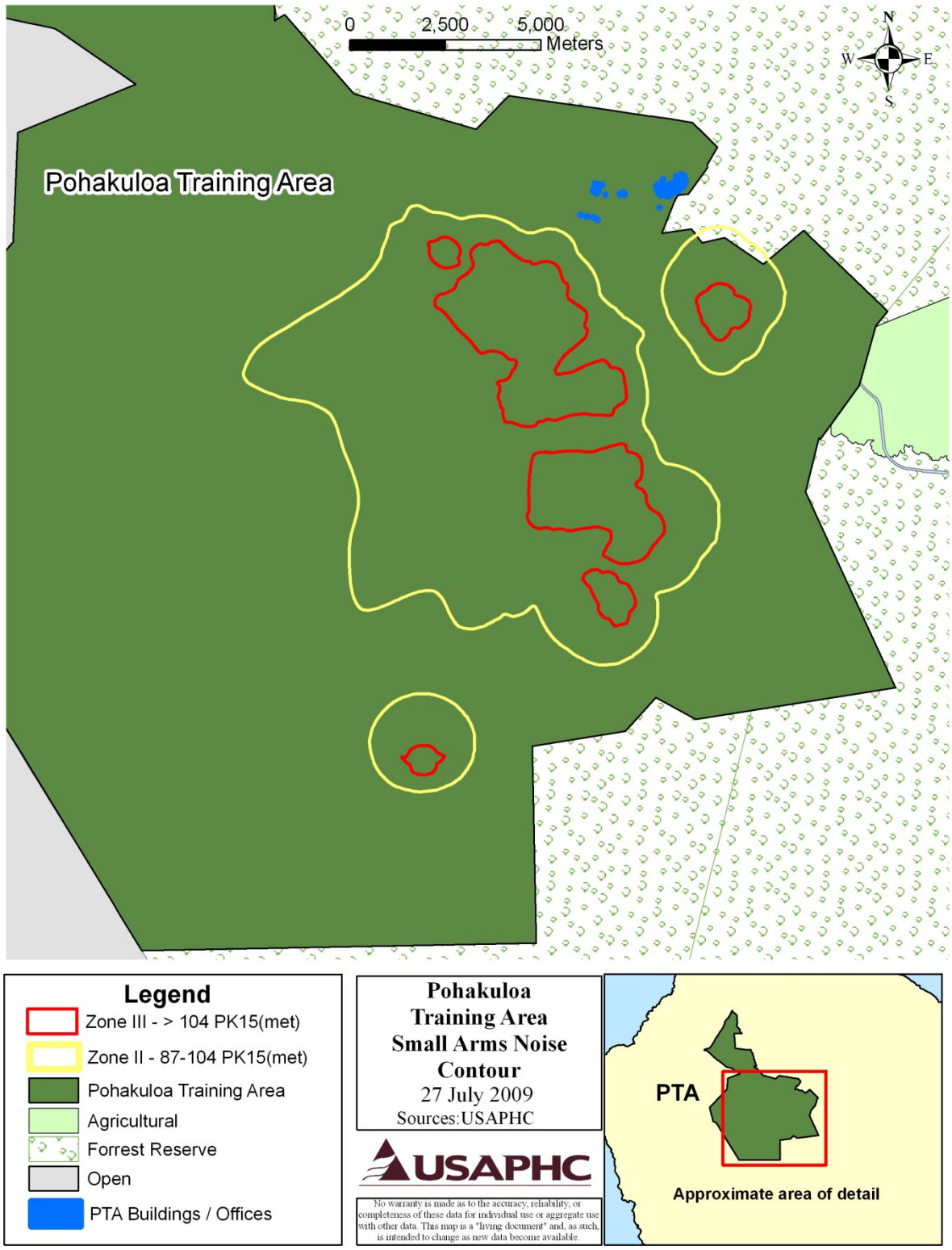

Figure 11- 4 Pohakuloa Training Area Small Arms Noise Contour

11.4.2 LARGE CALIBER WEAPONS AND DEMOLITION NOISE

As previously mentioned, Army Regulation (AR) 200-1 defines noise zones and recommended land use guidelines for large caliber weapons noise using both the C-weighted DNL (CDNL) metric and the PK15(met) noise metric (Appendix F). The CDNL metric is effective for land use planning, as the CDNL is an average which shows exposure over a period of time (generally CDNL contours are averaged annually). However, experience at Army installations has shown that *complaints* from large caliber weapons and demolition training/testing are usually attributed to a single loud event, at a particular point in time, versus the average noise dose received at any one location. Often complaints are received from areas that are considered "acceptable" with the noise environment using the CDNL metric. To this end, the Army has adopted the practice of assessing large caliber weapons noise using both the CDNL metric along with a supplemental "complaint risk" PK15(met) metric.

The CDNL noise contours for the existing large caliber operations at PTA are shown in Figure 11-5. These contours are based on 2007/2008 ammunition expenditure data (Appendix B), and include all operations averaged over 250 training days.

<u>Conclusions:</u>

- The majority of the Zone III noise contours are contained on post except for several small areas north extending approximately 150-200 meters in forest reserve land (Figure 11-5). The Zone II and LUPZ noise contours exist off post, but are contained entirely within forest reserve land. There are no incompatible land uses on or off post within the Zone II and Zone III noise contours.

- The risk of complaints off post would be extremely low or non-existent in the forest reserve area (Figure 11-6).

- The risk of complaints on post would be moderate in the PTA building and office area.

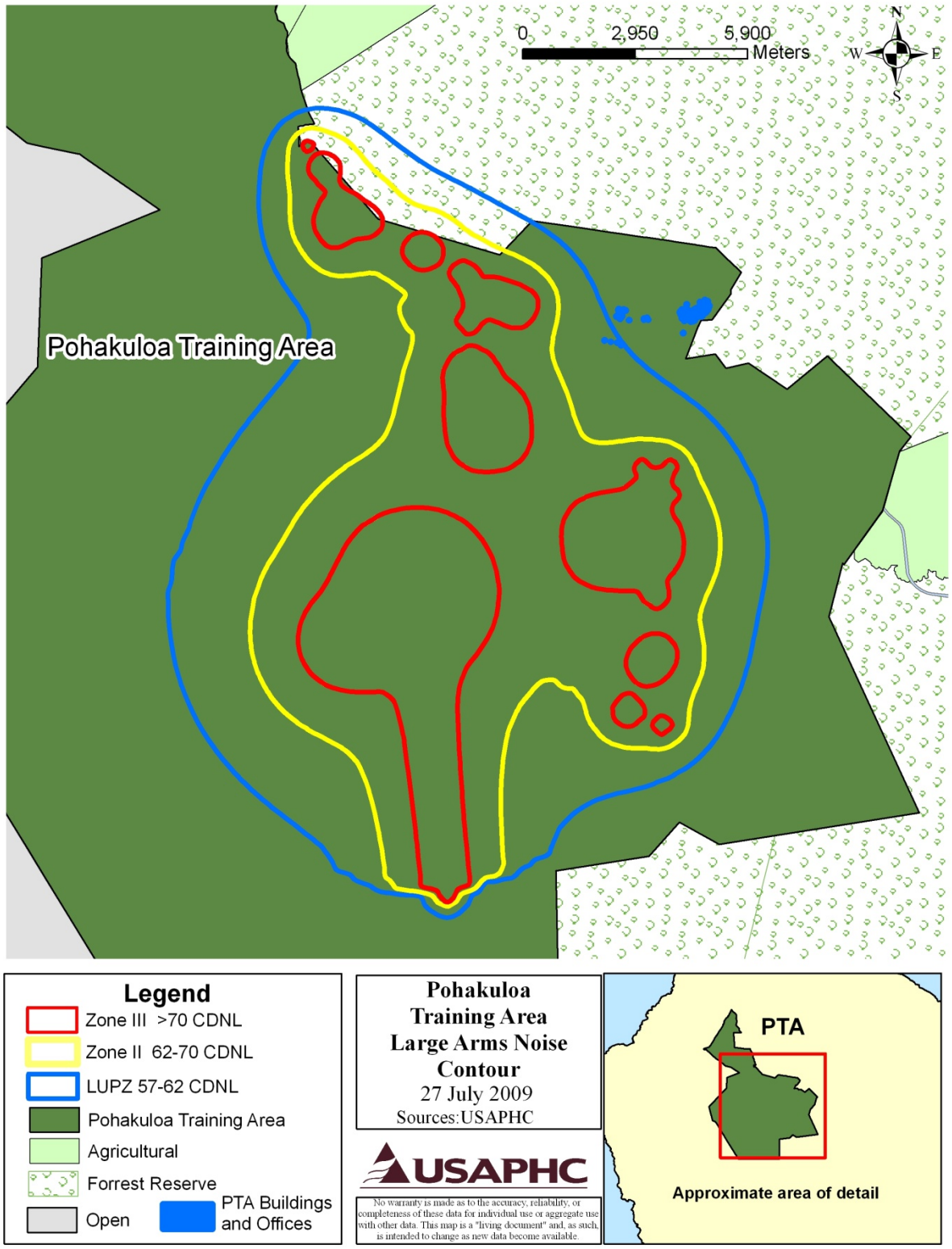

Figure 11- 5 Pohakuloa Training Area Large Arms Noise Contour

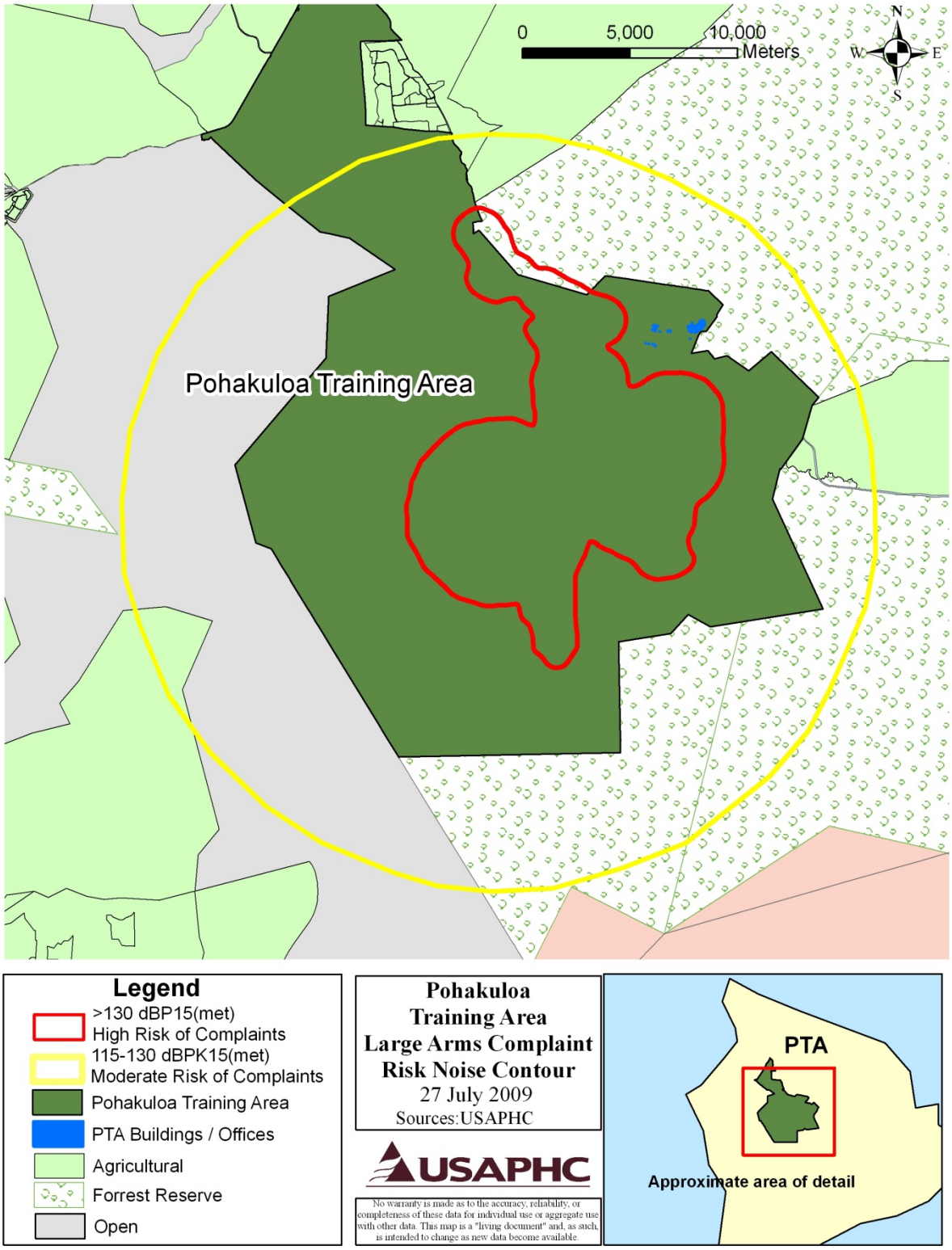

Figure 11- 6 Pohakuloa Training Area Large Arms Complaint Risk Noise Contour

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12.0

BRADSHAW ARMY AIRFIELD

12.1 GENERAL [33]

Bradshaw Army Airfield (BAAF) is a limited use airfield located at Pohakuloa Training Area (PTA) on the Big Island of Hawai`i (Figure 12-1). BAAF provides support for assigned and visiting aviation units and is located west of PTA's cantonment area. It has a single runway of 3700 feet which restricts the use to only small aircraft. The official airfield elevation is 6,190 feet and the longitudinal gradient is 3 percent. BAAF lies at the northern most edge of the saddle formed by the peaks of Mauna Kea and Mauna Loa, and is approximately 400 feet below the saddle's crest on the western downhill side. The terrain surrounding the airfield is very hilly with numerous puu's (cinder cones and/or hills) to the southeast through west-northwest. Vegetation is sparse with a complete absence of wooded areas

The Base Weather Station supports the 25th Infantry Division and its associate units at Wheeler Army Airfield and Schofield Barracks, the Hawai`ian Army National Guard Hilo, and the 45th Support Group (68th Medical Detachment). Deployments to the Big Island are usually on a quarterly rotation.

The weather forecasts BAAF frequently include fog, low ceilings, low level wind shear, turbulence and 15 knot gust spreads which severely limit aviation operations. The strong winds in the saddle are the most significant threat to operations. Light winds in the morning may turn into 30 knots with gusts to 45 knots by 1000L.

BAAF is the highest airfield in consistent use on the Hawai`ian Islands and is situated between the two highest peaks in the state.

12.2 SURROUNDING LAND USES

See Section 11.2 for surrounding land uses pertaining to PTA.

[33] http://www.globalsecurity.org/military/facility/bradshaw.htm

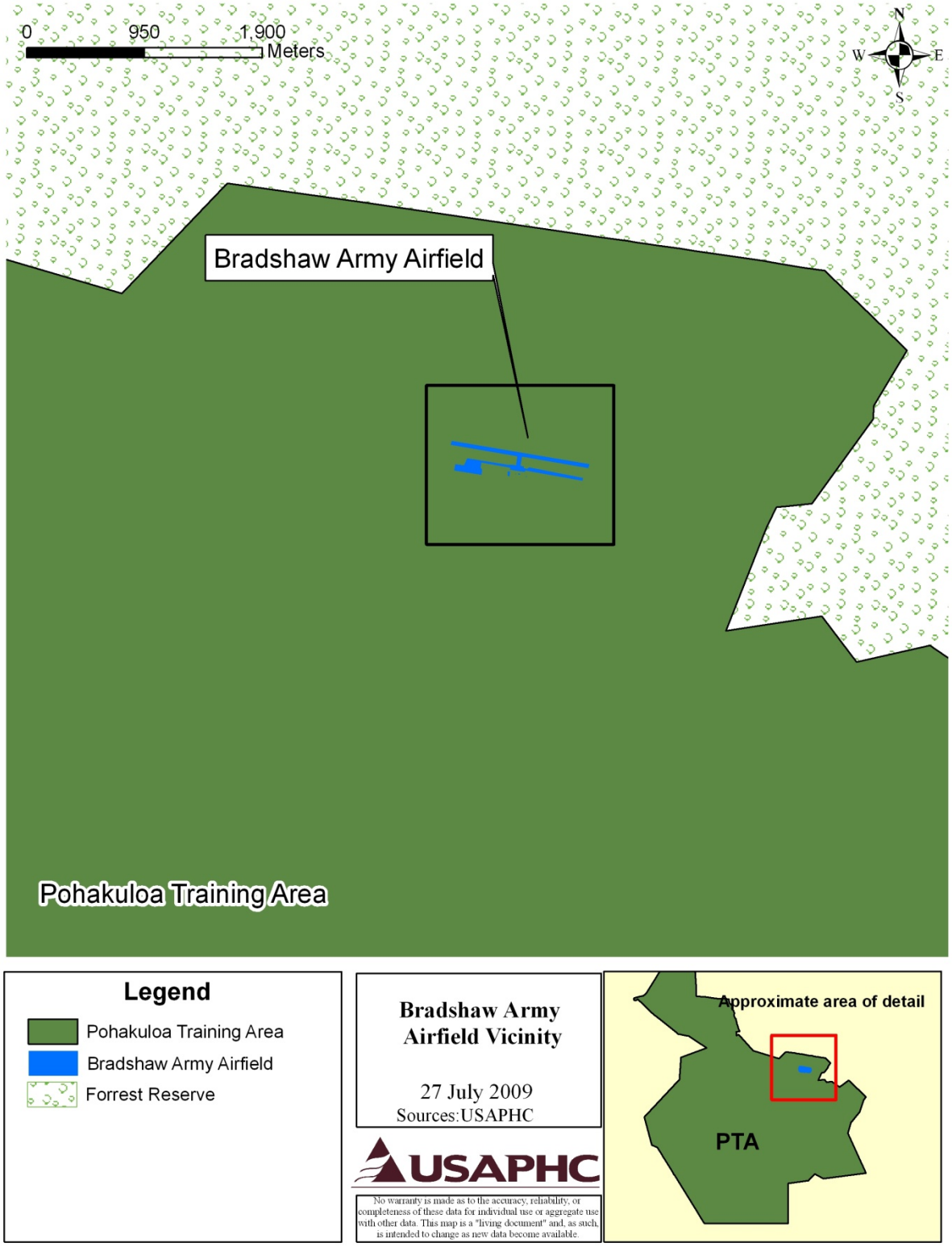

Figure 12-1 Bradshaw Army Airfield Vicinity

12.3 TRAINING

There are no aircraft permanently assigned at BAAF though the airfield is utilized by rotary wing AH-64, CH-47, OH-58, UH-60, and Dauphin along with fixed wing C-12, and C-130. Over the course of one year, the airfield averages only 1 flight each day for each aircraft.

12.4. CURRENT NOISE ENVIRONMENT

12.4.1 AIRCRAFT NOISE

The low number of military aircraft utilizing the flight corridors at BAAF will not generate A-weighted Day-Night average sound Level (ADNL) noise contours. Yet, there is the potential for aircraft to cause annoyance and possibly generate noise complaints while entering/exiting the airspace.

Scandinavian Studies (Rylander 1974 and Rylander 1988) have found that a good predictor of annoyance at airfields with 50 to 200 operations per day is the maximum level of the 3 loudest events. The maximum noise levels for the aircraft utilized in the flight corridors are listed in Table 12-1 and 12-2. These maximum levels are compared with the levels listed in Table 12-3 to determine the percent of the population that would consider itself highly annoyed. While annoyance levels may be lower at flight corridors with fewer than 50 operations per day, it is a tool in providing some indication of the percent of people who might be annoyed.

Slant Distance (feet)	Maximum Level, dBA					
	AH-64	CH-47	CH-53	Dauphin	OH-58	UH-60
200	92	92	102	85	87	88
500	83	84	94	76	79	80
1,000	77	78	88	68	72	73
1,500	73	74	84	64	68	69
2,000	70	71	81	61	65	66
2,500	67	68	78	58	62	63

TABLE 12-1 Maximum Noise Levels of Rotary Wing Aircraft.

Slant Distance (feet)	Maximum Level, dBA	
	C-12	C-130
200	88	100
500	79	92
1,000	73	85
1,500	69	80
2,000	67	77
2,500	65	75
5,000	57	66

TABLE 12-2 Maximum Noise Levels of Fixed Wing

Maximum, dBA	Highly Annoyed
90	35%
85	28%
80	20%
75	13%
70	5%

TABLE 12-3 Percentage of Population Highly Annoyed from Aircraft Noise. (Rylander 1974)

12.5 AIRCRAFT NOISE ABATMENT [34]

Residents of the State of Hawai`i are environmentally conscious. Pilots are trained to avoid unnecessary over flight of populated areas as well as single houses. In order to gain public acceptance, all pilots are trained to be sensitive to the concerns of the surrounding communities.

BAAF has a noise abatement policy in place and it is detailed in the draft copy of the USAG-HI Installation IASC SOP (Aviation Local Flying Rules):

NOISE-SENSITIVE AREAS. The local flying area for BAAF is the island of Hawai`i. Personnel assigned to BAAF Operations take an active role to ensure that military flight operations impact as little as possible on the local civilian population of the island.

a. The following areas have been established as noise sensitive areas by the Commander, PTA:

(1) Waikii Ranch (NW of BAAF), Noise Sensitive Area bounded by following grids (KC190006, KC210006, KB235985, KB241972, KB234962, KB190964). NO-FLY AREA within 1500' radius of GRID centered at (KB225982).

(2) Humuula Sheep Ranch (SE of BAAF), GRID (KB411809)

(3) Hawai`ian Historical Site, GRID (KC049169)

b. The avoidance distance will be as listed in the DOD FLIP En Route Supplement. If distances and altitudes are not depicted or listed, use the following:

(1) Remain above 2000 feet vertically above the highest obstacle.

(2) Avoid by 1500 feet laterally.

c. The Hawai`i Helicopter Operators Association has developed a Helicopter Sound Abatement Procedures Handbook. This handbook is based on the National Sound Abatement Program, "I Fly Neighborly." It lists noise-sensitive areas and describes the procedures used by civilian pilots while operating on the island of Hawai`i.

[34] USAG-HI Installation IASC SOP (Aviation Local Flying Rules) 22 Aug 08

13.0
LAND USE POLICY AND CONTROL

13.1 GENERAL

The key to the mutually beneficial coexistence of military installations and communities is sensible land use planning around the installation. In the end, the installation can do everything possible within its mission to limit noise, but if the planning around the installation is not prudent, incompatible uses will find their way to the installation's boundary and the installation's existence (and possibly the economic backbone of the community) could become jeopardized.

Sensible, proactive land use planning (i.e., before there is a problem) can create a win-win situation for all parties.

13.2 FEDERAL LAND USE CONTROL

The only direct land use controls available to the federal government result from fee-owned land and easements related to federal projects. Federal agencies such as the U.S. Natural Resources Conservation Service, U.S. Forest Service, U.S. Agricultural Stabilization and Conservation Service, and U.S. Geological Survey provide assistance to landowners to manage their land and water resources to maintain agricultural and aesthetic quality.

13.3 LAND USE PLANNING AND THE ARMY

A great part of the success of the United States of America can be attributed to its strong laws protecting personal property rights. The United States military is a constitutionally charged protector of those rights and has no interest in dictating what an owner may or may not do with his/her property, what a community should put in any particular place, or what value any given parcel of land should have. With that said, an installation would be remiss if it did not point out the benefits it brings to a community and how those benefits may be imperiled by the decisions (or lack thereof) of local community planners.

Communities all over the country have employed various means to protect entities that they deem to be valuable. This protection has ranged from implementing building codes to ensure that new construction in popular historic areas maintains the existing architectural heritage, to guarding the small-town feel of a Main Street by restricting the size of businesses that may enter a "downtown" business district. What all of these initiatives have in common is that they are intended to steer new development in a direction that is most appropriate given a need to preserve the value to the community of what has already come before. Sensible initiatives to ensure compatible land use around military installations are no different.

13.4 STATE OF HAWAI`I LAND USE CONTROL [35]

In 1961, the Hawai`i State Legislature determined that a lack of adequate controls had caused the development of Hawai`i's limited and valuable land for short-term gain for the few while resulting in long-term loss to the income and growth potential of our State's economy. Development of scattered subdivisions, creating problems of expensive yet reduced public services, and the conversion of prime agricultural land to residential use, were key reasons for establishing the state-wide zoning system.

To administer this state-wide zoning law, the Legislature established the Land Use Commission. The Commission is responsible for preserving and protecting Hawai`i's lands and encouraging those uses to which lands are best suited.

The Hawai`i State Land Use Law (Chapter 205, Hawai`i Revised Statutes) is unique in the history of Hawai`i land use planning. Originally adopted by the State Legislature in 1961, the Land Use Law establishes an overall framework of land use management whereby all lands in the State of Hawai`i are classified into one of four Districts:

- **URBAN**- The Urban District generally includes lands characterized by "city-like" concentrations of people, structures and services. This District also includes vacant areas for future development. Jurisdiction of this district lies primarily with the respective counties. Generally, lot sizes and uses permitted in the district area are established by the respective county through ordinances or rules.

- **RURAL** - Rural Districts are composed primarily of small farms intermixed with low-density residential lots with a minimum size of one-half acre. Jurisdiction over Rural Districts is shared by the Commission and county governments. Permitted uses include those relating or compatible to agricultural use and low-density residential lots. Variances can be obtained through the special use permitting process.

- **AGRICULTURAL** - The Agricultural District includes lands for the cultivation of crops, aquaculture, raising livestock, wind energy facility, timber cultivation, agriculture-support activities (i.e., mills, employee quarters, etc.) and land with significant potential for agriculture uses. Golf courses and golf-related activities may also be included in this district, provided the land is not in the highest productivity categories (A or B) of the Land Study Bureau's detailed classification system. Uses permitted in the highest productivity agricultural categories are governed by statute. Uses in the lower-productivity categories – C, D, E or U - are established by the Commission and include those allowed on A or B lands as well as those stated under Section 205-4.5, Hawai`i Revised Statutes.

- **CONSERVATION** - Conservation lands are comprised primarily of lands in existing forest and water reserve zones and include areas necessary for protecting watersheds and water sources, scenic and historic areas, parks, wilderness, open space, recreational areas,

[35] http://luc.state.hi.us/about.htm

habitats of endemic plants, fish and wildlife, and all submerged lands seaward of the shoreline. The conservation District also includes lands subject to flooding and soil erosion. Conservation Districts are administrated by the State Board of Land and Natural Resources and uses are governed by rules promulgated by the State Department of Land and Natural Resources.

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13.5 ACHIEVING LAND USE COMPATIBILITY

Achieving land use compatibility requires both flexibility and creativity from land use planners, installation commanders, and the citizenry. The previous sections of this document have detailed the existing and imminent encroachment threats, and given focused recommendations for how to remedy them. But, what do installations and communities do to tackle problems in the future?

In general, USAPHC uses the Federal Interagency Committee on Urban Noise (FICUN, 1980) guidelines (shown in Appendix E) when recommending land use options for areas near noise producing activities. While these guidelines only apply to noise measured in the A-weighted DNL (not blast noise), they apply to the noise produced by many of the most common sources such as transportation and maintenance/testing operations.

13.6 LOCAL LAND USE CONTROL

13.6.1 SCHOFIELD BARRACKS AND WHEELER ARMY AIRFIELD

From the Land Use Policies, Principles, and Guidelines (Ordinances from Honolulu) [36] :

Schofield Barracks/Wheeler Army Airfield supports the 25th Infantry Division and consequently has large areas committed to residential use, including commercial and recreational facilities. The bases also support quasi-industrial uses including operation and maintenance of heavy equipment and helicopter airfield operations and maintenance.

In addition to these urban uses, the base also includes large areas of open space, most of which is used for infantry training. These areas extend beyond the Urban Community Boundary. One area is west of Schofield Barracks urban areas, extending to the Waianae Mountains, and a second area known as the East Range extends south and east from Wahiawa to the Koolau Mountains.

PLANNING PRINCIPLES

The general policies and the guidelines for circulation systems and landscape treatment for residential communities should be applied to military lands in residential use.

[36] http://www.co.honolulu.hi.us/Refs/ROH/central/coch3.htm

GUIDELINES

The following guidelines should apply to development on the two bases, and where appropriate, in areas adjacent to the bases. The City will request the Department of Defense consider them in planning for development at each of the bases:

SCHOFIELD BARRACKS/WHEELER ARMY AIRFIELD

Uses within the base should include residential, commercial, recreational and civic areas for the support of military personnel and their dependents and may be expanded to accommodate additional residents on base and/or augmented activities which do not significantly conflict with surrounding residential communities.

The visibility of security fencing and utilitarian military facilities from off-base should be minimized through the planting of a landscape screen, consisting of trees and hedges, along highway frontages.

Adequate buffers should be provided for residential developments immediately adjacent to the Central O`ahu training areas to ensure that residents will not be adversely impacted by noise or other environmental impacts of the training activities.

13.6.2 BIG ISLAND HAWAI`I (PTA AND BRADSHAW ARMY AIRFIELD) [37]

Most of the Big Island Hawai`i is zoned agriculture, conservation, park or related land use categories. Of the Big Island's 2.5 million-plus acres, only about 54,000 or two percent is designated as urban area while 1.3 million acres – or 50 percent is designated as conservation. The remainder is designated as agricultural or rural.

Proposed residential and commercial buildings on the Big Island undergo a rigorous approval and permitting process. The State of Hawai`i has an Environmental Impact Statement (EIS) law, which requires an (EA) environmental impact assessment (for public review) when any development activity is proposed for State or County lands or using State or County funds. It also applies to any development proposed in conservation districts, shoreline areas or historic sites, or when cultural, historical or burial sites are encountered in the course of development. Limited availability of water, sewer and other infrastructure keeps development manageable. Hotels and resorts are clustered to avoid sprawl.

13.7 THE JOINT LAND USE STUDY (JLUS)

The JLUS is a collaborative land use planning effort involving the military installation and adjacent local governments that evaluates the planning rationale necessary to support and encourage compatible development of land surrounding the installation. Put another way, it is a means for the installation and local governments to develop a land use plan that effectively addresses the long-term land use needs of the of the surrounding communities, yet still provides the military with the mission flexibility it needs to meet training doctrine.

[37] http://www.bigisland.org/ecotourism/1013/sustainable-tourism-in-practice

Specifically, the JLUS program is sponsored by the Department of Defense Office of Economic Adjustment (OEA) (DODI, 1983), and it provides technical and financial assistance to the planning agencies for developing master plans that are consistent, when economically feasible, with the noise, accident potential, and safety concerns from an installation's training and operations. The cost of the plan is split between the OEA and the jurisdictions involved.

The scope of the program is divided into three major tasks:

1. Impact Analysis. Impact analysis provides and in-depth review of existing and proposed land use patterns; drainage (as it effects land use designations); mission encroachment (particularly noise); transportation improvements, existing and proposed routes; and noise/vibration.

2. Land Use and Mission Compatibility Plan. Examines the above findings to identify conflicts in land use and provide alternative land use solutions; to project the impact on growth potential for adjacent areas; and to project the impact of military missions on the surrounding jurisdictions.

3. Implementation. Lists a series of actions and proposals for adoption by local jurisdictions to resolve land use conflicts and move toward a compatible land use plan for the installation, the adjacent counties, and the communities therein.

While the study report makes certain recommendations, it must be kept in mind that each participating jurisdiction must decide which recommendations are best suited to their particular needs. Implementation follows the final recommendations at the discretion of elected officials in each jurisdiction and the installation military command.

Many states including North Carolina (Fort Bragg, Pope AFB, MCAS Cherry Point), Pennsylvania (NAS/NRB Willow Grove), and South Carolina (MCAS Beaufort) have had success utilizing the JLUS program to direct their land use strategies. On top of this, for fiscal year 2005, the Army had eight more JLUS' funded and underway in Massachusetts, Mississippi, Arizona, Georgia, California, Kansas, and Pennsylvania (awaiting outcomes).

13.8 LAND USE PLANNING OPTIONS

The following is a list of the major land use planning tools available to help local governments create areas of compatible use around military installations. These may be used individually or in combination, and a detailed explanation of the pros and cons of each is available in Appendix D.

1. Zoning
2. Overlay Districts
3. Easements
4. Transfer of Development Rights (TDR)
5. Land Purchase
6. Building Codes

7. Subdivision Regulation
8. Health Codes
9. Disclosure of Noise Levels
10. Land Banking
11. Special Tax Treatment
12. Capital Improvements Program (CIP)
13. Development Loan Restrictions
14. Public/Private Leaseback
15. Sales Agreement
16. Deed/Covenants
17. Purchase of Development Rights
18. Eminent Domain
19. Purchase Option

While this is a substantial portion of the options available, installations and local governments are strongly encouraged to be creative to find the equitable solutions that best work for their situation.

13.9 ENVIRONMENTAL JUSTICE

Environmental Justice (EJ) is an important consideration in any land use plan. It is defined by the U.S. Enviromental Protection Agency as the "fair treatment of people of all races, cultures, and incomes, regarding the development of environmental laws, regulations, and policies."

Over the last decade, there has been growing attention focused on the impact of environmental pollution on particular segments of our society. The concern that some populations bear a disproportionate amount of adverse health and environmental effects led President Clinton in 1994 to issue Executive Order 12898 focusing federal agency attention on these issues. To this end, installations and local governments should ensure that the EJ philosophy is embraced when any new measures are enacted to ensure compatible development around military installations. Decisions should be based strictly on the operational, safety, and environmental considerations of both the installation and the community, not on whether a particular group is more or less likely to complain.

13.10 CONCLUSION

The evenhanded resolution of any situation involving a disparate population of stakeholders requires flexibility, creativity, direction, good-will, and the most accurate information available. Effective land use planning is no different.

And, while the entire labyrinth of local regulations cannot be explained in this document, it is imperative that installation commanders and decision-makers become familiar with the local land use regulations and development climate around their installations in order to properly gauge the possibility of impending encroachment issues. Maintaining a familiarization with local regulations by visiting local government offices; a knowledge of federal/installation-initiated tools and programs (such as the JLUS); and a consciously cultivated relationship with

local government officials (by making the Installation's views and preferences known at local planning and zoning meetings) are the best ways to address issues of encroachment before they in fact become issues.

This Operational Noise Management Plan provides the information and the direction, but it is up to the installations and communities to provide the other elements to ensure a mutually beneficial coexistence.

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Appendix A

Description of Noise, Noise Evaluation, and Contouring

A.1 INTRODUCTION

Military noise comes from a variety of sources and is a concern for a number of reasons. Of course big guns make big sounds, but the noise made by everything from generators to trucks to machine shop tools must be considered as well. For the military, issues involving noise can be broken down into two components: hearing conservation as it pertains to the physical damage to the ear caused by sound, and operational noise as it relates to complaints and encroachment.

The first involves the exposure to noise by individuals who are performing their duties. Since loud sounds are known to cause immediate and/or cumulative hearing damage, the military must be constantly monitoring the noise exposure of its employees and soldiers, both in day-to-day and combat situations.

The second (and the focus of this piece) centers upon the problems caused when military sounds irritate the pubic—whether through poor decisions by installation personnel, or through or increasing encroachment around a once-remote installation.

In order to understand how military sounds become a problem, it is important to understand the science of sound, and what happens when a sound becomes a noise.

A.2 WHAT IS NOISE?

Noise is simply unwanted sound. So, in the context of hard science, there is no difference between the two. However, whether something is a "sound" or a "noise" has a great influence over the military's everyday planning and policy decisions as it tries to fulfill its Constitutionally-charged duty to protect the citizens of the United States of America.

In short, sound isn't noise until someone says it is; and when it is, it needs attention.

A.3 THE FUNDAMENTALS OF SOUND AND ACOUSTICS

Sound is a physical phenomenon created by minute variations about a mean pressure (or *vibrations*) that travel through a medium such as air or water. This variation in pressure takes the form of waves and, under ideal conditions, these waves travel evenly away from the source much like the ripples created when a pebble is dropped into calm water.

However, life on earth is rarely so perfect and the travel of these waves is always being influenced by variables such as temperature, terrain, and barriers. Add to those physical influences the fact that our human experience of audible sounds depends on the pattern of

vibrations form the source, the way our hearing mechanism interprets these vibrations, and how our personalities affect how we feel about those vibrations, and one can begin to grasp the complexity of issues involving sound and noise.

The field of science that deals with all of these variables as well as the production, control, reception, effects, and propagation is called *acoustics*.

A.3.1 THE CHARACTERISTICS OF SOUND

As an object moves back and forth in the atmosphere, it collides with the surrounding air particles creating a pressure disturbance. As those air particles collide with adjacent air particles, the pressure disturbance begins to spread away from the source of vibration. At the ear, this disturbance generates a vibration in the eardrum that is transmitted via a network of bones to the cochlea, which then converts the vibration into an electrical signal that the brain can interpret.

A sound is measured by gauging the alternate *compression* ("bunching") and *rarefaction* ("spreading") of the acoustic pressure disturbance above and below the normal atmospheric pressure, and is quantified in units called *Pascals* (Pa). Normal atmospheric pressure at sea level is 100,000 Pa, and sound waves generally travel at approximately 1,100 feet (335 meters) per second through air. For reference, the variation about this atmospheric pressure can be a little as 0.0006 Pa (or 60μPa) for a whisper at 2 meters, to 1,000 Pa for an M16 rifle shot at the firer's ear.

As with all waves, the energy and effects of a sound are dependent upon the sound wave's *frequency* and *wavelength*. Frequency is the number of compressions of rarefactions per unit of time. Wavelength is the distance between successive compressions or successive rarefactions (see Figure A-1).

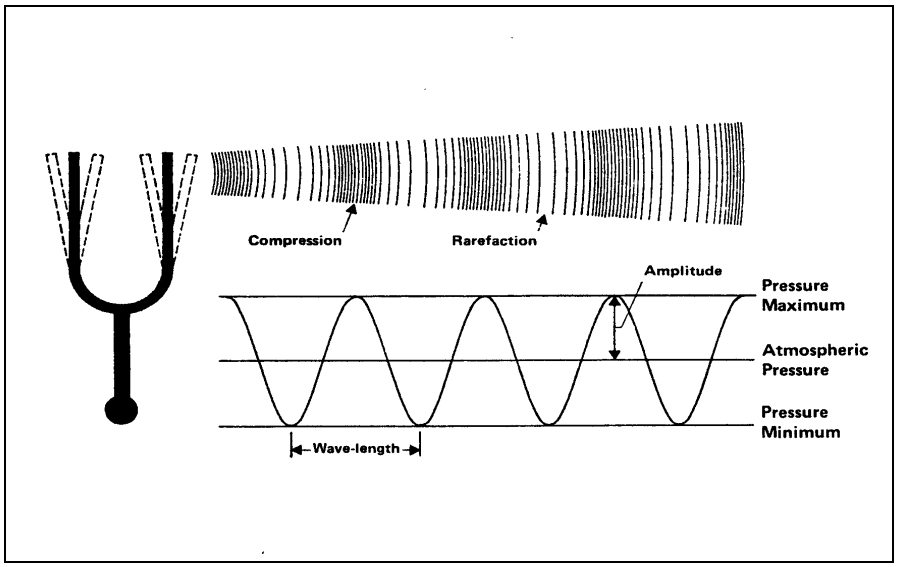

Figure A-1 Acoustics of a Pure Tone

Of course, sounds can bring us important information and/or pleasure. But, whether or not that is the case is dependent on two things: the content of the sound and the predisposition of the receiver to the sound.

When a sound brings neither pleasure nor information, it is safe to call it a noise.

A.3.1.1 SOUND CONTENT AND HUMAN HEARING

The content of a sound is determined by three defining characteristics:

(1) its spectral or frequency content;

(2) its loudness or intensity; and

(3) its time pattern

But, the importance of each of these is also dependent upon the innate response of a human ear that's primary function was to keep people alive, not critique M-16 fire.

A.3.1.1.1 SPECTRUM AND FREQUENCY

Sound frequency is measured in terms of cycles-per-second or Hertz (Hz). The normal human ear can detect sounds ranging from about 20 Hz to 20,000 Hz (for reference, the average dog's hearing range is approximately 20-45,000 Hz). However, not all sounds in this wide range are heard equally well; the human ear is most sensitive to frequencies in the 1,000 to 4,000 Hz range.

As mentioned earlier, a vibrating object produces a sound wave with a characteristic frequency (a *tone*). But, there are no pure tones in the natural soundscape. Instead, any given sound found in nature is actually comprised of a complex combination of individual frequency components produced by the many different vibrational and oscillatory modes of the sound source. The total of all of these individual frequency components is known as a sound's *spectrum*, and knowledge of a sound's spectrum is a key in any attempt to mitigate the sound.

A.3.1.1.2 LOUDNESS AND DECIBELS

The concept of *volume* (i.e., relative loudness or quiet) is fundamentally about the level of sound pressure hitting the eardrum. Historically (and for obvious reasons), the first scientists to seriously study the ear's response to sound pressure were telephone engineers. These scientists soon discovered that the human ear responds to a very broad range of pressures and subsequently invented a logarithmic scale using the *decibel* (dB) as its unit of measurement.

The scale is zeroed at the beginning of human hearing (20μPa) and, since the scale is logarithmic, each one dB increase is a 10x increase in pressure (see Figure A-2).

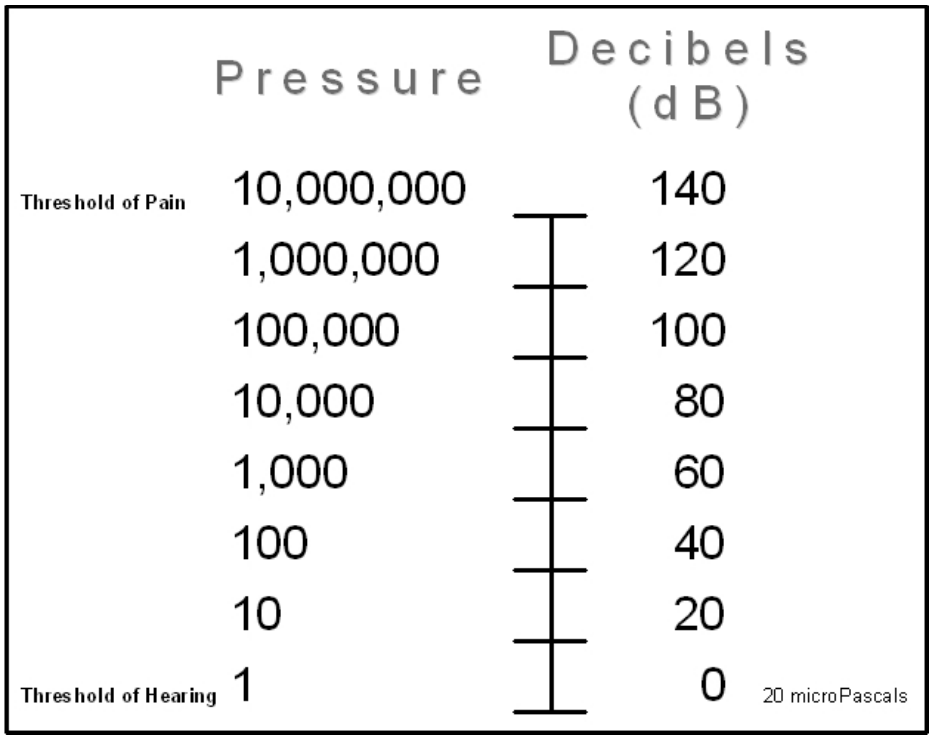

Figure A-2 Relationship between Sound Pressure and Decibels

For humans, the upper tolerable limit of loudness before hearing damage occurs depends on the frequency and duration of the sound. For example, a 20 millisecond rifle shot at a 140 dB level can damage the hearing in some unprotected ears. But a howitzer shot at 140 dB, with its lower frequency (i.e., it's not as "sharp" as the rifle shot), is far less likely to cause hearing damage. Alternately, a passing sound at 120 dB is enough to cause only discomfort, while several minutes of such exposure can cause damage. And, moving further down the scale, one could tolerate as much as 8 hours of 85 dB before damage becomes a possibility.

Though laboratory studies have demonstrated a greater acuity, for practical purposes it takes a plus-or-minus three dB change in pressure (roughly a doubling or halving of energy) for a person to notice a difference across most audible frequencies.

But, because of the logarithmic nature of the decibel, dBs do not add directly. To get an exact answer, the root pressures of the sounds to be added must be combined and then converted to decibels using the following formula:

$$\text{Pressure (dB)} = 10 \log \left(\frac{\text{Measured Pressure}}{\text{20 microPascals}}\right)$$

Table A-1 shows the short cuts to dB addition, but these are only to be used for quick approximations.

When Two Levels Differ By:	Add the Following to the Higher Value:
0 to 1 dB	3
2 to 3 dB	2
4 to 9 dB	1
10 or more dB	0

Table A-1 Shortcuts to Decibel Addition

A.3.1.1.3 VIBRATION

Often hand-in-hand with the discussion of loudness comes the phenomena of *vibration*. Vibration in the context of military training is caused by the impact of lower frequency sound waves on unsecured objects. In fact, there are situations where vibration can be the primary irritant to the public, because the sound making the vibration is too low for the human ear to hear. Thus, a citizen may have little idea that training operations are occurring at all until a picture falls off of the wall.

Vibration issues can largely be abated by appropriate construction techniques (e.g., heavy outer walls, suitable duct design, sealing of cracks, etc.) and prescient site planning. Additionally, while many citizens are fearful that vibration may damage their homes, the threshold for damage to even a poorly constructed house is far greater than the tolerance of the occupants is likely to be.

A list of "dos" and "don'ts" is published in an Army Construction Engineering Research Laboratory (CERL) report, Expedient Methods for Rattle-Proofing Certain Housing Components, and that report (or additional information on vibration in general) can be obtained from CERL or USAPHC.

A.3.1.1.4 TIME PATTERNS

Time patterns are extremely important to the discussion of sound because it is so important in predicting annoyance.

Sound can be classified into four basic categories that define its basic time pattern:

(1) Ambient. Ambient sound is the ever-present collection of background sounds at any given place. Ambient sound can be strictly natural such as frogs and cicadas in the deep woods, strictly mechanical such as street noise in a busy city, or a combination of both like that which is found in the suburbs. It is important to consider the existing ambient soundscape because what exists already has much to do with how annoying people will find a new sound. For example, the hum of a generator will be much better tolerated by those already living in an area of high mechanized ambient noise than those living in the far woods.

(2) *Steady-state*. Steady-state sound is a sound of consistent level and spectral content such as that which originates from ventilation or mechanical systems that operate more or less continuously. From a military perspective, generators and aircraft run-up sounds are the most prominent steady-state sounds and, as a rule, the longer a steady-state sound persists, the more annoyed people will be.

(3) *Transient Sound*. Transient sound has a clearly defined beginning and end, rising above the background and then fading back into it. Transient sounds are typically associated with "moving" sound sources such an aircraft overflight or a single vehicle driving by, and they usually last for only a few minutes at the most. The annoyance caused by transient sounds is dependent upon both the maximum level and the duration.

(4) Impulsive Sound. Impulsive sound is of short duration (typically less than one second) high intensity, abrupt onset, rapid decay, and often a fast-changing spectral composition. It is characteristically associated with such sources as explosions, impacts, the discharge of firearms, the passage of supersonic aircraft (sonic booms), and many industrial processes. Impulsive sound can be particularly annoying because of the "startle factor" where the receiver has no warning that exposure to a loud sound is imminent.

The temporal aspect of a sound is important when it comes to predicting annoyance. Even a sound that is barely audible can be extremely irritating if it is continuous and is occurring at an inconvenient time (such as bedtime).

A.4 NOISE EVALUATION AND METRICS

There is little disagreement about the fact that noise must be regulated to some degree in order to maintain the quality of life for the public at large. However, noise is one of those things where everyone seems to know it when they hear it, but it has been historically difficult to define in words or numbers. This has been particularly irksome to lawmakers, because any laws regulating noise must be clearly understood to both producers and receivers in order to be effective. Consequently, over the past 30 years a wide variety of acoustic measures and rating scales have been developed for the purpose of quantifying the sound generated by particular sources.

To date there is no perfect way to quantify noise for every circumstance and condition, but there are ways to assign meaningful numbers to sounds so that they can be compared from situation to situation.

A.4.1 WEIGHTING

As stated above, due to the natural response of the human ear, the perception of loudness is not consistent across frequencies. For instance, at any sound pressure less than 90 dB, a 1000 Hz tone would sound louder than a 100 Hz tone. While this is a bit of an oversimplification, essentially, as the frequency drops, it takes more pressure (volume) to maintain the same sense of "loudness."

Accordingly, weighting scales have been developed so that the intensity of a sound (or noise) can be equalized and brought in line with the actual human perception. The weighting scales that concern operational noise are the A-scale (A-weighting) and the C-scale (C-weighting), both specified by an American National Standards Institute standard (ANSI, 1983). Figure A-3 shows the relationship between the two scales.

A-weighting

The *A-weighting* of decibels (dBA) was designed to work primarily with higher frequency sounds. In military noise, this would encompass such sounds as those from generators, aircraft, maneuver drills, and general transportation.

C-weighting

The *C-weighting* of decibels (dBC) is used for intense signals containing low frequency sound energy like those that emanate from large gun blasts, sonic booms, and detonations.

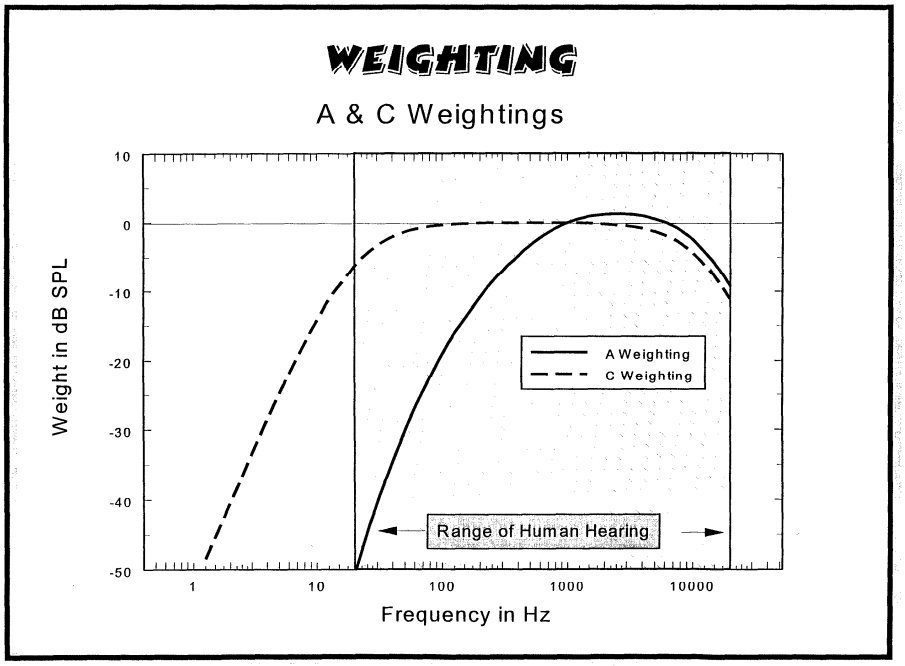

Figure A-3 A- and C- Weighting Scales

A.4.2 NOISE METRICS

The weighting scales are only one part of noise evaluation. In order to get a proper idea of the overall effect of noise, one must combine the weighting scales with the effects of a sound's time pattern to get a meaningful, all-encompassing cumulative noise measurement that can be used to compare noise exposure across a variety of situations.

Here, too, there are several choices of metrics depending on the noise environment to be measured and exactly for what the data is to be used. Many countries have their own standard metrics, but the U.S. military is concerned primarily with the following:

- Equivalent-continuous Sound Level (L_{eq})
- Day-Night Level (DNL)
- Sound Exposure Level (SEL)
- PK15(met)
- Unweighted Peak

A.4.2.1 EQUIVALENT-CONTINUOUS SOUND LEVEL (L_{eq})

Since annoyance increases with the number of times an intrusive sound is experienced during a given period of time, the L_{eq} is a way of capturing the annoyance of a number of intrusions by "averaging" acoustical energy over a prescribed time period. The time period can be any length, but it is usually taken in some meaningful block of time such as an 8-hour L_{eq} for an office or a 24-hour L_{eq} for a residence. Figure A-4 illustrates how the daily variation of traffic noise can be summarized in terms of a single 24-hour L_{eq} value.

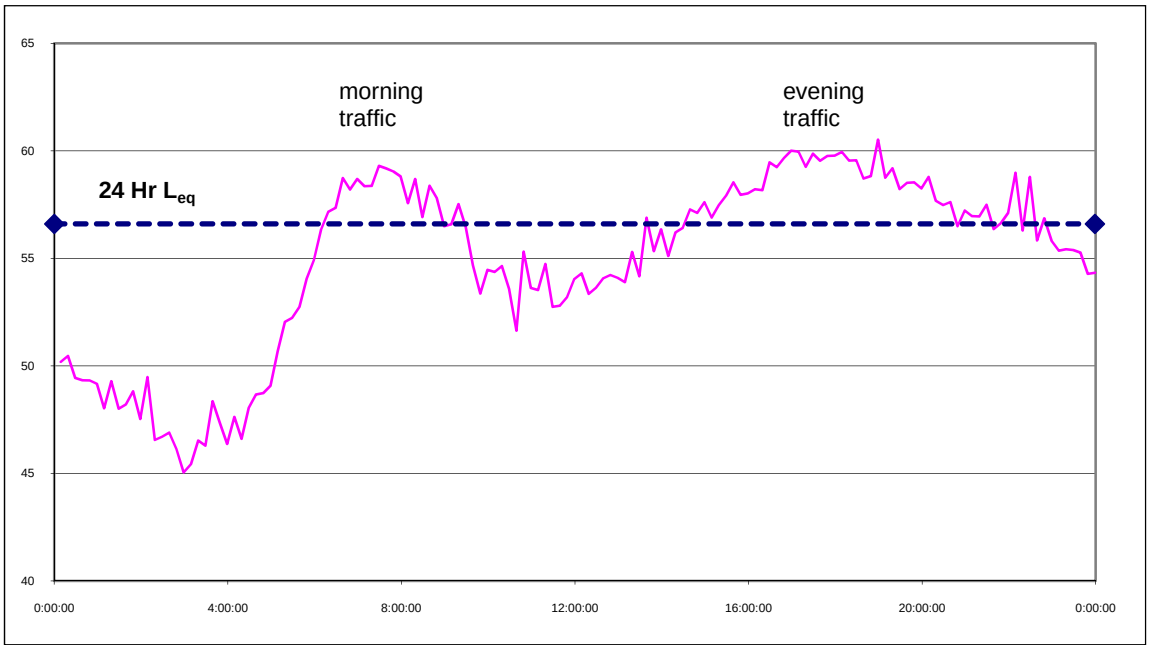

Figure A-4 Equivalent-continuos Noise Level (L_{eq})

A.4.2.2 DAY-NIGHT AVERAGE SOUND LEVEL (DNL)

The DNL is an average like the L_{eq} but with a 10dB "penalty" inflicted on sounds occurring between the hours of 10:00 p.m. and 7:00 a.m. (a particularly intrusive time when people are usually sleeping). As discussed above, the DNL may be A-weighted (ADNL) or C-weighted (CDNL) depending on the noise being measured. This average is calculated over any specified

amount of time, but usually it is 250 training days for active military and 104 days for National Guard sites.

Also, within the DNL, there is a further penalty known as the *onset rate penalty*. For people living along aircraft flight routes, it was found that the DNL was underestimating their annoyance. So, this penalty (known as the L_{DNmr}) is used by the U.S. Air Force to take into account the sudden onset and sporadic nature of these sounds.

A.4.2.3 SOUND EXPOSURE LEVEL (SEL)

Since, prolonged, low-intensity events can be just as annoying as short, high-intensity events, the SEL is a way of capturing the annoyance of both variables in terms of a single number. It is the total energy of a sound event normalized to a specific amount of time (e.g., one second) so that sounds of different durations may be compared directly. Put another way, the SEL represents all the acoustic energy of an event as if it occurred within a one second period.

A.4.2.4 PK15(met)

PK15(met) is the peak sound level, factoring in the statistical variations caused by weather, that is likely to be exceeded only 15% of the time (i.e., 85% certainty that sound will be within this range). This metric exists only in modeling—one cannot take a PK15(met) measurement on the ground—and it is used for land use planning with small arms and as additional information for large arms and other impulsive sounds. It has gained popularity for military applications in recent years because it is a metric that works very well at showing just how loud things are likely to get at a particular location. Unfortunately, PK15(met) does not take duration or incidence into consideration, so it cannot tell how often things will be that loud.

A.4.2.5 UNWEIGHTED PEAK

On of the simplest ways to measure sound is through the use of unweighted peak (dBP). This is the peak, single event sound level on the ground, without any particular certainty–such as with the 85% certainty built into the PK15(met) above. This is a real-time measurement that is affected by everything from the weather to the length of the grass. As such, it is highly variable.

A.4.3 A BRIEF HISTORY OF NOISE EVALUATION IN THE U.S. GOVERNMENT

Before the 1970's, every organization had its own preferred set of noise evaluators (or metrics). Since each noise evaluator was developed for a specific purpose, data from one noise evaluator could not be reliably compared to that of another.

However, the field moved toward standardization when, in carrying out its responsibilities under the Noise Control Act of 1972 (PL 92-574 1972), the U.S. Environmental Protection Agency recommended the adoption of the LEQ (and its 24-hour cousin, the DNL).

In recommending the DNL, the EPA noted that most noise environments are characterized by repetitive behavior from day-to-day, with some variation imposed by differences between

weekday and weekend activity, and seasonal fluctuations. Consequently, the DNL's annual average accounts for this variation and complements the fact that annoyance is generally caused by long-term dissatisfaction with the noise environment. It must be kept in mind, though, that the DNL is not an effective predictor of complaints, because complaints tend to represent an individual's immediate dissatisfaction with the noise environment, not a general annoyance.

So, the acceptance of the DNL helped to predict annoyance (and general disruption patterns), but it could not fully address the issue of complaint prediction. Consistent prediction of complaints, it has been found, is much more achievable when dealing with peak noise levels rather than averages. As a result, in 2004, the U.S. Army Construction Engineering Research Laboratory (USACERL) and USAPHC together helped to usher in the PK15(met) evaluator as a means to predict complaint potential and supplement the information given by the DNL figures.

A.5 NOISE CONTOURING

The various metrics described above produce numbers that can be compared to one another. But, it is difficult to make a number meaningful to someone interested in where the noise is going. To that end, the idea of noise contouring on maps was born.

Contours on a map are made by connecting points of equal values. Most commonly, points of equal elevation are connected to form the contour lines most typically found on topographical maps. But, points of many other themes can be detected to give a visual representation of the extent or degree of something. So, for noise, computer programs have been developed that model the genesis and propagation of sound from particular sources, and then connect points of equal decibel value to show areas where a particular sound intensity can be expected.

For instance, Figure A-5 is an example of a map showing peak noise contours. The operator of the computer model may plot whatever values she/he wishes to show, but this example shows the 130 dBP line (red) and the 115 dBP line (blue). While the lines will never be absolutely exact (due to the nature of sound, they can fluctuate quite a bit as conditions change), what this map in effect says is that all of the area inside of the blue line will start at 115 dB and grow louder as it gets closer to the red 130 dB line. And similarly, once at the red 130 dB line, the sound level will grow louder still all the way to the source.

This is eminently useful because it shows both the installations and the public not only where the sound/noise is going, but at what levels. With that, installations, local governments, and individuals can use these maps to make informed choices based on their temperaments, tolerances, and philosophies concerning noise.

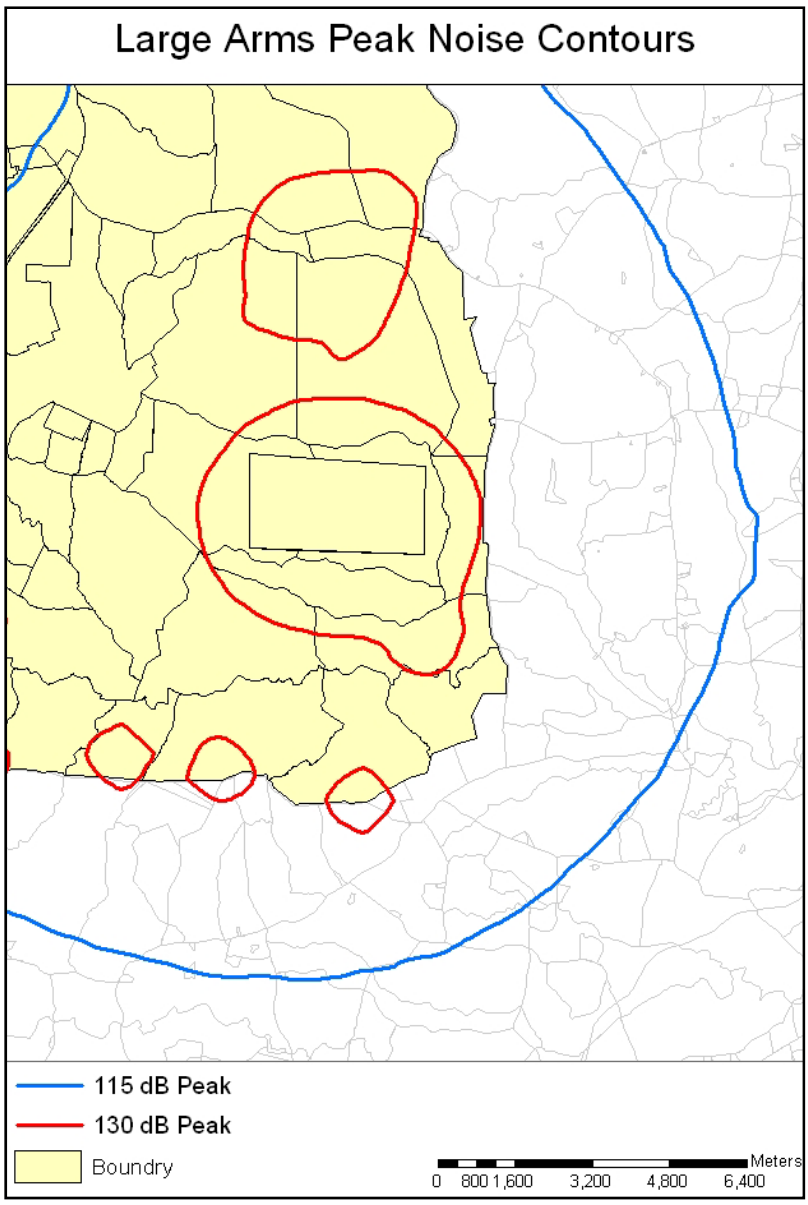

Figure A-5 Example of a Map Showing Peak Noise Contours

A.5.1 COMPUTER PROGRAMS

The relatively simple looking output of a map showing noise contour lines is actually the result of some comparatively complicated computer programs. In fact, most of these programs are in perpetual states of evolution as new data become available and advances in computing power allow for more variables to be factored into creating the final contour.

Table A-2 lists the most popular noise mapping programs and some of their preferred usage characteristics.

Model	Timeframe	Characteristic	Source	Use
NOISEMAP	Long-term	Transient	Fixed-wing aircraft	Airbase noise exposure, AICUZ
Rotorcraft Noise Model	Long-term & single events	Transient	Helicopters and tiltrotors	Airbase noise exposure, AICUZ, range noise
ROUTEMAP	Long-term	Transient	Fixed-wing	MTRs
MR_NMAP	Long-term & single missions	Transient	Fixed-wing	MOA, MTR, Special uses ranges
BoomMap	Long-term	Impulse	Sonic booms	Supersonic MOA ops
BNOISE2	Long-term & single events	Impulse	OD & large guns	Ranges and OD pits
SARNAM	Long-term & single events	Impulse/transient	Small arms	Firing range
MENU10	Single event	Transient	Fixed wing	Flyover noise levels
MENU11	Single event	Transients	Fixed wing	Ground run up noise levels
NMSIM	Single event	Transients	Fixed wing	Subsonic aircraft operations
PCBOOM3	Single event	Impulse	Fixed wing	Sonic boom analysis
SIPS	Single event	Impulse	Blast	Open detonation blast
NAPS	Single event	Impulse	Blast	Open detonation blast
TNM	Long-term	Transient	Road traffic	Highway and road noise exposure
RWNM	Long-term	Transient	Trains and guided rail vehicles	Rail operations, yard and tracks

Table A-2 Noise Models and Their Uses

Regarding the contours featured in Operational Noise Plans created by USAPHC:

- Small arms noise contours are generated by the Small Arms Range Noise Assessment Model (SARNAM) Version 2.6. This model incorporates the latest available information on weapons noise source models (including directivity and spectrum), sound propagation, effects of noise mitigation and safety structures (walls, berms, ricochet barriers, etc.), and community response protocols for small arms noise. It also includes an extensive selection of weapons in the source library, can handle multiple ranges of various types, and is designed to maximize user productivity.

- Blast noise (i.e., explosions and large arms) contours are generated by the BNOISE2 program, Version 1.3. It accounts for spectrum and directivity of both muzzle blast and projectile sonic boom while also considering issues of propagation including land/water boundaries and terrain.

- Aircraft noise contours are generated by NOISEMAP with inputs of aircraft type, altitude, power setting, speed, and number of operations.

All of the computer models work in generally the same fashion. The weapon type and number of rounds fired is combined with various geographic and atmospheric data (location, direction of fire, weather, etc.). The user then defines which contours he/she wishes to see, the program calculates how far the sound will travel under those conditions, and the resulting contours are then overlaid onto a conventional map of the area.

In spite of the research invested and the intricacies of the programs, it must be said that the outputs of the modeling programs are not always exactly what may be found "on the ground" at any given moment. The problem lies not with the calculations or algorithms, but with the number of variables that practical and computing considerations limit the user to inputting. Put another way, there are far too many variables on the ground (even down to how long the grass is) to ever truly simulate the natural world.

So, when done properly, the contours produced can be relied upon to paint a clear picture of the general noise environment of an area, and show information that is of the integrity needed to make prudent planning and zoning decisions.

Additional information on noise models or contouring procedures can be obtained from the USAPHC's Operational Noise Group.

A.5.2 WHAT AFFECTS CONTOUR SHAPES?

In an ideal world (for acousticians, anyway), all noise contours would be perfect circles because the noise would travel from the source at the same speed and intensity in every direction. But, the geology, geography, climatology, and physics of our planet create an environment where external forces are acting on sound waves the second they are created. Those waves may be directed by the nature of the source, reflected by a wall, refracted by some mountains, attenuated by winds, intensified by atmospheric conditions, or absorbed entirely by a thick coniferous forest.

All of these situations then ply that theoretically perfect circle, stretching it in some places (e.g., pushing through a mountain gap), and smashing it in others (such as in the direction against a heavy breeze).

A.6 CONCLUSION

The science of measuring and modeling unwanted sounds is constantly evolving, just like the relationships between military installations and the communities that surround them. As defense spending continues to drive innovation and support a large sector of our nation's economy, the weapons are getting more powerful and louder, and population pressures are increasing around once-remote installations.

But, while evolving relationships always pose new challenges, they also always pose new opportunities. Understanding the way sound behaves and utilizing the noise monitoring and modeling tools available are critical to making proper land use decisions in and around installations, so that the installations and the surrounding communities continue to thrive in each other's presence

Appendix B

Operations and Utilization Data for Noise Contours

B.1 SMALL ARMS DATA - BASELINE UTILIZATION – SCHOFIELD BARRACKS, SCHOFIELD BARRACKS EAST RANGE, DILLINGHAM AND KAHUKU TRAINING AREA (01 OCTOBER 2007 - 11 SEPTEMBER 2008)

Ranges	PISTOL .38 CAL, LIVE	PISTOL 9MM, LIVE	PISTOL 9MM, BLANK	PISTOL .357 MAG LIVE	PISTOL, .45 CAL LIVE	RIFLE .22 CAL LIVE	RIFLE .22 CAL BLANK	RIFLE .223 CAL LIVE	RIFLE .223 CAL BLANK	RIFLE 5.56MM LIVE	RIFLE 5.56MM BLANK	RIFLE 7.62MM, LIVE	RIFLE .30 CAL LIVE	RIFLE .380 CAL LIVE	MACHINE GUN, 7.62MM, LIVE	MACHINE GUN, 7.62MM BLANK	MACHINE GUN 50 CAL, LIVE	MACHINE GUN 50 CAL, BLANK	SHOTGUN 10 GAUGE	SHOTGUN 12 GAUGE	TRAINER AT4, 9MM TPT
DILLINGHAM P-1											◊										
DILLINGHAM P-2											◊										
DILLINGHAM P-3											◊										
KTA-A-1											◊					◊					
KTA-A-2											◊					◊					
KTA-B-1											◊					◊					
KTA-B-2											◊					◊					
KTA-C-1											◊					◊					
KTA-C-2											◊					◊					
KTA-D-1											◊					◊					
KTA-D-2											◊					◊					
KTA-WTRTRANK-LZ											◊										
KTA-X-STRIP LZ											◊										
SB AMBUSH 2		◊								◊	◊				◊	◊		◊		◊	
SB UAC										◊	◊				◊	◊	◊			◊	
SB-CATM																					
SB-CATM		◊								◊					◊				◊	◊	
SB-CR-1		◊								◊	◊				◊	◊		◊			
SB-CR-2		◊								◊	◊	◊			◊					◊	
SB-CR-2A	◊	◊		◊		◊		◊		◊	◊	◊	◊		◊	◊				◊	
SB-CR-3A	◊	◊		◊	◊	◊				◊	◊	◊	◊	◊	◊					◊	
SB-CR-3B		◊								◊	◊				◊					◊	
SB-ER-10											◊					◊					
SB-ER-11											◊					◊					
SB-ER-12											◊					◊					
SB-ER-13											◊					◊					
SB-ER-1A											◊					◊		◊		◊	

SB-ER-1B											◊					◊		◊		◊	
SB-ER-2											◊					◊		◊		◊	
SB-ER-3A											◊					◊		◊		◊	
SB-ER-3B											◊					◊		◊		◊	
SB-ER-4											◊					◊		◊			
SB-ER-5											◊					◊		◊			
SB-ER-6A											◊					◊					
SB-ER-6B											◊					◊					
SB-ER-KUTREE											◊					◊					
SB-ER-LOWER 72											◊					◊					
SB-ER-UPPER 72											◊					◊					
SB-FP 213		◊								◊	◊										
SB-GR HOUSE		◊								◊	◊				◊	◊		◊			
SB-IBC TRENCH		◊								◊	◊				◊	◊				◊	
SB-IBC VILLAGE		◊								◊	◊				◊	◊		◊		◊	
SB-KR-2		◊								◊	◊				◊						
SB-KR-3		◊								◊	◊	◊			◊	◊	◊	◊		◊	
SB-KR-4																					
SB-KR-4 ZERO		◊								◊	◊	◊			◊	◊		◊		◊	
SB-KR-5		◊								◊	◊				◊	◊	◊	◊		◊	
SB-KR-5 ZERO		◊								◊	◊				◊	◊		◊			
SB-KR-6		◊								◊	◊				◊	◊		◊		◊	
SB-KR-8										◊	◊				◊	◊		◊		◊	
SB-KR-9										◊	◊					◊	◊	◊			
SB-MF-CPQC 4		◊										◊					◊				
SB-MF-MPMG 2		◊								◊	◊				◊		◊			◊	
SB-MF-MRF 3		◊								◊	◊				◊		◊				◊
SB-PORTER										◊	◊				◊						
SR SKEET RING																				◊	
SR-1											◊					◊		◊			
SR-2A											◊					◊		◊			
SR-2B											◊					◊		◊			
SR-3											◊					◊		◊			
SR-6A											◊					◊		◊			
SR-CTF MOUT			◊				◊				◊					◊		◊			
SR-CTF ZERO		◊							◊	◊	◊				◊	◊		◊		◊	
SR-ENG TA		◊																			
SR-FP 102 LZ											◊				◊						
SR-INF DEMO		◊								◊	◊				◊					◊	
SR-QTR 2										◊					◊						
SR-SHOOTHOUSE		◊			◊					◊	◊					◊				◊	

B.2 SMALL ARMS DATA - BASELINE UTILIZATION – POHAKULOA TRAINING AREA (30 SEPTEMBER 2007 – 01 OCTOBER 2008)

Ranges	PISTOL 9MM, LIVE	RIFLE 5.56MM LIVE	RIFLE 7.62MM, LIVE	MACHINE GUN 50 CAL, LIVE	MACHINE GUN 50 CAL, BLANK	RIFLE 5.56MM BLANK	RIFLE 7.62MM BLANK	SHOTGUN 12 GAUGE	SHOTGUN .410
PTA FP 424/12						◊	◊		
PTA FP 429/13						◊			
PTA FP 501/16						◊			
PTA LZ ROB/1						◊			
PTA POW CAMP						◊	◊		
PTA RG 01 DEF		◊		◊		◊	◊		
PTA RG 01 OFF	◊	◊	◊	◊	◊	◊	◊		
PTA RG 02	◊							◊	
PTA RG 03				◊					
PTA RG 04		◊							
PTA RG 05		◊							
PTA RG 05A		◊							
PTA RG 07		◊	◊						
PTA RG 08	◊	◊	◊	◊			◊		◊
PTA RG 08B				◊					
PTA RG 08S		◊	◊	◊					
PTA RG 10		◊		◊	◊	◊			
PTA RG 10 OFF	◊	◊	◊	◊	◊	◊	◊		
PTA RG 11T		◊	◊	◊	◊	◊	◊		
PTA RG 12		◊	◊	◊	◊	◊	◊	◊	
PTA RG 12A		◊	◊	◊	◊	◊	◊		
PTA RG 13		◊	◊	◊	◊	◊			
PTA RG 13A	◊		◊						
PTA RG 20		◊	◊	◊		◊			
PTA RG 8C SHOOTHOUSE	◊	◊	◊			◊			
PTA TA 03		◊			◊	◊		◊	
PTA TA 08					◊	◊		◊	
PTA TA 12							◊	◊	
PTA TA 13						◊	◊		
PTA/RG 01		◊	◊			◊			

B.3 LARGE ARMS AND EXPLOSIVE DETONATION DATA – BASELINE UTILIZATION – SCHOFIELD BARRACKS (01 OCTOBER 2007 - 11 SEPTEMBER 2008)

RANGE	WEAPON	DAYTIME (0700-2200)	NIGHTTIME (2200-0700)
SB/GRHOUSE	Simulator, Hand Grenade M116	3	0
	Hand Grenade, Fragmenting	100	0
SB/IBC TRENCH	Simulator, Hand Grenade M116	20	0
SB/INC VILLAGE	Simulator, Hand Grenade M116	8	0
SB/KR-9	Demolition, 2.5 lbs M1 Chain	1	0
SB/MF-2 MPMG	81mm Mortar, HE	27	3
	Hand Grenade, Fragmenting	1	0
	Bangalore, Kit (M1A1)	22	0
	Demolition, 1.25 lbs	139	0
	Demolition, 1.25 lbs Block	9	0
	Demolition, 2 lbs Block M118	20	0
	Dynamite, Military M1	11	0
	Water Gel Explosive (MY77)	5	0
	Mine, AT M15	6	0
	Mine, AT M21	5	0
	Mine, Claymore M18A1	1	0
	Shape Charge, 40 lbs	18	0
	25mm Gun, Inert	1884	0
	105mm Howizer, HE	88.2	9.8
SB/MF-2/3/4/5 40MM IMPACT	40mm Grenade, HE	3200	0
SB/MF-3 MRF	81mm Mortar, HE	27	3
	Hand Grenade, Fragmenting	1	0
	Bangalore, Kit (M1A1)	22	0
	Demolition, 1.25 lbs	139	0
	Demolition, 1.25 lbs Block	9	0
	Demolition, 2 lbs Block M118	20	0
	Dynamite, Military M1	11	0
	Water Gel Explosive (MY77)	5	0
	Mine, AT M15	6	0
	Mine, AT M21	5	0
	Mine, Claymore M18A1	1	0
	Shape Charge, 40 lbs	18	0
	105mm Howizer, HE	88.2	9.8

SB/MF-4 CPQC	81mm Mortar, HE	27	3
	Hand Grenade, Fragmenting	1	0
	Bangalore, Kit (M1A1)	22	0
	Demolition, 1.25 lbs	139	0
	Demolition, 1.25 lbs Block	9	0
	Demolition, 2 lbs Block M118	20	0
	Dynamite, Military M1	11	0
	Water Gel Explosive (MY77)	5	0
	Mine, AT M15	6	0
	Mine, AT M21	5	0
	Mine, Claymore M18A1	1	0
	Shape Charge, 40 lbs	18	0
	105mm Howizer, HE	88.2	9.8
SB/MF-5 DEMO	2.75 IN Rocket, HE	5	0
	Hand Grenade, Fragmenting	1	0
	Bangalore, Kit (M1A1)	26	0
	Cratering Charge, 40 lbs	44	0
	Demolition, 1.25 lbs	642	0
	Demolition, 1.25 lbs Block	9	0
	Demolition, 2 lbs Block M118	20	0
	Demolition Kit, 1.25 lbs (M757)	27	0
	Demolition Sheet, 38 Ft 0.5 lbs/Ft	38	0
	Dynamite, 0.25 lbs Block TNT	25	0
	Dynamite, Military M1	11	0
	Water Gel Explosive (MY77)	5	0
	Mine, AT M15	18	0
	Mine, AT M21	16	0
	Mine, Claymore M18A1	1	0
	Shape Charge, 40 lbs	63	0
SR/CTF-MOUT	Demolition, 1.25 lbs	7	0
SR/CTF-Z/Q	Demolition, 1.25 lbs	7	0
	Demolition Kit, 1.25 lbs (M757)	13	0
	Demolition, Roll M186	210	0

SR/FP-HALO	Bangalore, Kit (M1A1)	22	0
	Demolition, 1.25 lbs	131	0
	Demolition Kit, 1.25 lbs (M757)	13	0
	Demolition, Roll M186	210	0
	Mine, AT M15	6	0
	Mine, AT M21	5	0
	Shape Charge, 40 lbs	18	0
SR/INF DEMO	Hand Grenade, Fragmenting	1535	0
	Demolition, 1.25 lbs	138	0
	Demolition, 1.25 lbs Block	18	0
	Dynamite, 0.25 lbs Block TNT	10	0
	Mine, Claymore M18A1	35	0

B.4 LARGE ARMS AND EXPLOSIVE DETONATION DATA – HIGHEST PROJECTED UTILIZATION – MAKUA

	50 CALFEX	
	Day Rounds 0700-2200)	Night Rounds (2200-0700)
155mm HE	6480	3240
105mm HE	1420	1000
81mm HE	1450	1000
60mm HE	1100	750
60mm Inert	1350	950
Banaglore	100	50
Claymore	250	200
Shape (40 lbs C4)	36	0
Shape (15 lbs C4)	80	0
Cratering Charge	24	0
C4, 2 lbs	100	50
Grenades	1000	700
AT-4 anti-tank rockets	100	50
2.75 caliber HE rockets	1400	1400
TOW missles, Inert	50	50

B.5 LARGE ARMS AND EXPLOSIVE DETONATION DATA – BASELINE UTILIZATION – POHAKULOA TRAINING AREA (30 SEPTEMBER 2007 – 01 OCTOBER 2008)

RANGE	WEAPON	DAYTIME (0700-2200)	NIGHTTIME (2200-0700)
PTA FP 401/9	105mm Howitzer, Inert	51.3	5.7
	105mm Howitzer, HE	1552.5	172.5
	155mm Howitzer, HE	174.6	19.4
PTA FP 402/9	105mm Howitzer, Inert	270.9	30.1
	105mm Howitzer, HE	602.1	66.9
	155mm Howitzer, HE	108.9	12.1
PTA FP 405/9	155mm Howitzer, Inert	11.7	1.3
	155mm Howitzer, HE	297	33
PTA FP 409/9	155mm Howitzer, HE	38.7	4.3
PTA FP 410/12	155mm Howitzer, Inert	46.8	5.2
	155mm Howitzer, HE	153	17
PTA FP 411/9	155mm Howitzer, Inert	31.5	3.5
	155mm Howitzer, HE	114.3	12.7
PTA FP 420/12	155mm Howitzer, Inert	107.1	11.9
	155mm Howitzer, HE	489.6	54.4
PTA FP 424/12	105mm Howitzer, Inert	16.2	1.8
	105mm Howitzer, HE	100.8	11.2
PTA FP 431/15	155mm Howitzer, Inert	11.7	1.3
	155mm Howitzer, HE	350.1	38.9
PTA FP 435/15	155mm Howitzer, Inert	99	11
	155mm Howitzer, HE	383.4	42.6
PTA FP 436/15	155mm Howitzer, Inert	10.8	1.2
	155mm Howitzer, HE	48.6	5.4
PTA FP 438/15	105mm Howitzer, Inert	426.6	47.4
	105mm Howitzer, HE	321.3	35.7
	155mm Howitzer, Inert	42.3	4.7
	155mm Howitzer, HE	218.7	24.3
PTA FP 442M/9	60mm Mortar, Inert	164	0
	60mm Mortar, HE	232	0
	81mm Mortar, Inert	1072	0
	81mm Mortar, HE	2729	0
	120mm Mortar, Inert	177	0
	120mm Mortar, HE	68	0
	90mm Gun, HE	15	0

PTA FP 501/16	105mm Howizer, HE	108	12
	155mm Howitzer, Inert	24.3	2.7
	155mm Howitzer, HE	292.5	32.5
PTA FP 503/16	155mm Howitzer, HE	36.9	4.1
PTA FP 801M	60mm Mortar, Inert	6	0
	120mm Mortar, Inert	441	0
	120mm Mortar, HE	197	0
PTA FP 802M	60mm Mortar, Inert	32	0
	60mm Mortar, HE	666	0
	81mm Mortar, Inert	875	0
	81mm Mortar, HE	235	0
	120mm Mortar, Inert	7	0
	120mm Mortar, HE	78	0
	Demolition, MK74 (M832), 0.31 lbs	22	0
PTA FP 804M	60mm Mortar, Inert	96	0
	60mm Mortar, HE	1389	0
	120mm Mortar, Inert	902	0
	120mm Mortar, HE	22	0
PTA FP 807M	60mm Mortar, Inert	193	0
	60mm Mortar, HE	898	0
PTA POW CAMP	Simulator, Ground Burst M115A2	5	0
PTA RG 01 DEF	2.75 IN Rocket, HE	21	0
	Demolition Sheet, 38 Ft 0.5 lbs/Ft	2	0
PTA RG 01 OFF	Simulator, Hand Grenade M116	20	0
	Demolition, 1 lbs	400	0
PTA RG 03	40mm Grenade, HE	1772	0
PTA RG 05	Hand Grenade, Fragmenting	1696	0
PTA RG 05A	Hand Grenade, Fragmenting	206	0
PTA RG 08A	AT4 Rocket, HE	9	0
	Dragon Rocket, HE	4	0
	TOW Missile, HE	20	0
PTA RG 09	Bangalore, Kit (M1A1)	36	0
	Bangalore, Kit (M1A2)	5	0
	Cratering Charge, 40 lbs	5	0
	Demolition, 1 lbs	142	0
	Demolition, 1.25 lbs	202	0
	Demolition, 2 lbs	2	0
	Demolition, 2.25 lbs	2	0
	Demolition, 2.5 lbs Block M5	45	0
	Demolition, 2.5 lbs Block M2	6	0
	Demolition Flex Linear, 0.1926 lbs (MM46)	1	0
	Demolition Flex Linear, 0.44 lbs (MM30)	4	0
	Demolition Kit, 1.25 lbs (M757)	150	0
	Demolition Sheet, 25 Ft 0.8 lbs/Ft	32	0
	Mine, Claymore M18A1	25	0
	Shape Charge, 15 lbs	6	0
	Shape Charge, 40 lbs	5	0

PTA RG 10	Simulator, Ground Burst M115A2	1	0
PTA RG 10 OFF	60mm Mortar, HE	48	0
	81mm Mortar, Inert	2	0
	AT4 Rocket, Inert	57	0
	AT4 Rocket, HE	57	0
	Hand Grenade, Fragmenting	107	0
	40mm Grenade, HE	96	0
PTA RG 13	105mm Howitzer, Inert	163.8	18.2
PTA RG 13A	AT4 Rocket, Inert	41	0
	AT4 Rocket, HE	11	0
	40mm Grenade, HE	2284	0
	Demolition, 0.25 lbs	64	0
	Demolition Kit, APOBS (MN79)	8	0
PTA RG 15	2.75 IN Rocket, Inert	7133	0
	Hellfire Missle, HE	38	0
PTA RG 16	20mm Gun, Inert	2600	0
	20mm Gun, HE	200	0
	30mm Gun, HE	400	0
	Bomb, CBU-59A/B (E016)	6	0
	Bomb, MK82 500 lbs.	181	0
	Bomb, MK83 1000 lbs.	22	0
	Bomb, 2000 lbs. (E756)	16	0
	Bomb, Practice 9 lbs. (E962)	34	0
	Bomb, Practice 25 lbs. (E969)	10	0
	2.75 IN Rocket, Inert	36	0
PTA RG 20	2.75 IN Rocket, Inert	91	0
	Hellfire Missle, HE	19	0
PTA RG 8C SHOOTHOUSE	Simulator, Hand Grenade M116	15	0

B.6 WHEELER AAF DATA

Wheeler AAF

June 2008 Traffic Count

Aircraft Type	Daytime Activity (0700-2200)	Nighttime Activity (2200-0700)
CH-47	1,014	649
CH-53	203	129
OH-58	609	389
UH-60	2,029	1,297
C-130	54	34
Single Engine Prop	34	21
Twin Turbo Prop	26	17

Average Daily Traffic Count

Aircraft Type	Daytime Activity (0700-2200)	Nighttime Activity (2200-0700)
CH-47	51	32
CH-53	10	7
OH-58	30	20
UH-60	101	65
C-130	2	2
Single Engine Prop	2	1
Twin Turbo Prop	2	0

Appendix C
Guidelines for Discussing Noise Contour Maps

C.1 INTRODUCTION

Noise contour maps are the best way to show where noise is likely to go and at what intensity. Though much effort has been put into the creation of the computer programs that generate the noise contours, putting a highly variable concept onto a 2-dimensional piece of paper is a precarious science. Often, people viewing a noise contour map erroneously assume that the simplicity of the medium (i.e., the piece of paper) equates to the relative difficulty of the subject. The fact is, all of the intricacies of sound cannot be completely and accurately be portrayed in such a simplistic manner, but noise contour maps are the best way available and are quite effective if explained properly.

Note: If one is going to be charged with explaining noise contours (or any other potentially controversial subject) to the public on a regular basis, it is advised that the individual take a class in risk communication.

C.2 PREPARATION

Preparation is the primary ingredient needed to get any message across to an audience. Logically, one must first understand the message themselves before they can expect to credibly deliver it to anyone else.

It is not required that an individual be an expert on every aspect of the creation of the map. But, the concept of credibility (which will be a recurring theme in this Section) depends upon the presenter being knowledgeable and trustworthy. Proper preparations should include:

- Knowing inside and out the meaning of a particular set of contours (i.e., what the noise contours do say, and what they do not say).
- Familiarizing oneself with the basics of sound, how it travels, what effects that travel, and the relationship between sound and annoyance.
- Familiarizing oneself with the computer modeling and Geographic Information System (GIS) applications used to create the contours and maps.
- Learning about the concerns and/or biases of the audience.

Establishing credibility allows for the audience to trust your facts and helps bridge the gap in understanding that skepticism can create.

C.3 MEANING OF THE CONTOURS

A primary source of misunderstanding is how the contours are "interpreted." In reality, the contours are a stark picture of what is happening based on the parameters that have been input into the models, not an artist's rendition. Consequently, there is only one way to "read" the contours. Interpretation becomes a factor only when members of the audience are deciding if what the contours say is a good or a bad thing.

C.3.1 WHAT NOISE CONTOURS *CAN* TELL US

Noise contours are best at advising people of the approximate distribution of the noise coming from a particular source; in this case, military installations. Accordingly, if a person feels that there may be a chance that they are noise-sensitive, the contour map can give that individual an idea of where it might not be best for he/she to live.

Also, noise contours are excellent for making comparisons between the noises generated under one set of circumstances to those generated under another. This is especially useful when deciding such things as under what weather conditions it is best to train, whether a proposed location would work well for a new range, or to what degree troop deployments/reassignments will impact the surrounding areas.

C.3.2 WHAT NOISE CONTOURS *CANNOT* TELL US (WITH CERTAINTY)

Anyone explaining noise contours should first and foremost be aware that the noise levels do not stop at the line on the map. Most contours are averages of some sort and these averages are necessary because the infinite number of physical and meteorological variables at any given location would require an equally infinite number of maps to show them all. Thus, contours are representations of what someone is likely to experience under a given set of circumstances, and they cannot say that it is too loud for an assisted living center on one side of the road but not the other.

Also, it must be pointed out that contours change (sometimes often) due to weather, training schedules, deployments, technologies, etc. And, though what is shown on a map has a built in level of conservatism, it by no means suggests that things will never be louder or quieter at a given location.

Furthermore, contours cannot say whether or not the amount of noise shown to be in a particular area is going to be bothersome; this is up to individuals to decide and is a product of many variables. For instance, a relatively modest sound level at a house that is located next to a busy street is likely to be accepted quite differently than the same sound level at a house located on a canyon ridge all by itself.

In short, noise contours deal only with noise generalities and cannot reliably give information beyond noise (e.g., predict that houses "here" are worth more or less than houses over "there").

C.4 THE BASICS OF SOUND AND ANNOYANCE

Explaining the limits of the noise contours inevitably generates questions regarding why it is so difficult to pin down exactly where noise is going to travel and at what levels. The answer is that the propagation of sound and human perceptions of sound are dependent on so many variables that it impossible to cement exactly what will irritate a particular person.

The physical propagation of sound is affected by weather, terrain, distance, barriers, and the nature of the sound itself (i.e., different frequencies have different travel characteristics). In fact, weather has a profound affect on the degree to which a sound "lands" at a particular location, and that is of course a variable that can literally change from hour-to-hour. Appendix A gives a more in-depth description of the science of sound.

Human perception is even more challenging to account for on a single map. From county to county, ZIP code to ZIP code, and house to house, people's ideas of when a sound becomes noise can differ markedly. These differences in perception can be attributed to such varied sources as:

- The physical state of the individual's hearing ability (i.e., is the individual's hearing health good or bad?)
- Past experiences (i.e., could the individual have experienced trauma in the past that makes them particularly sensitive to loud or sharp sounds?)
- Attitude toward the noise source (i.e., does the receiver dislike the military?)
- General temperament (i.e., is the individual "jumpy?")

By understanding the relationship between the physical behavior of sound and some of the human variables that can turn a sound into a noise, we can paint a clearer picture to an audience about how they can each use the noise contours to make the decisions that best suit their individual situations.

C.5 COMPUTER MODELS AND GIS

It is also difficult to explain with any validity what the noise contours mean if one knows nothing about the process that created them.

The specific process of creating noise contours varies by what is creating the noise and, accordingly, which model is used to make the picture. But, the general idea is that pertinent information (such as the item making the noise, its location, the direction of fire/travel, weather conditions, etc.) is entered into the appropriate computer model, the model outputs a picture based on the noise metric specified, and then that picture is imported into a GIS program so that a map can be created.

However, while the computer models used by the military are some of the best available, they do have important limitations. First, no matter how sophisticated, no model can take into account every terrain variable at a given location unless models were specifically developed for every installation (which would cost an enormous amount, if it were even possible). Second, the databases of noise producers in the models are representative of the military's equipment, but may not contain individual specifications for every variety of a particular piece of equipment.

So, taken together, these two limitations further prevent the resolution of the noise contours from reaching the "street level," and they advance the idea that noise sensitive persons must take into consideration all available information before making a choice that may conflict with an existing noise environment (such as buying a home next to a highway or military installation).

In summary, taking the time to explain how the models work will draw an audience's expectations more toward what the computer models can actually provide.

C.6 AUDIENCE

While it has been mentioned previously that the information on a noise contour map is absolute and not necessarily up to interpretation, the type of audience to whom one is presenting noise contour information has an enormous impact on exactly how that information should be presented. For example, the social atmosphere created by a group of installation commanders is likely to be far different than the atmosphere in a meeting of developers and county planners.

So, most audiences are going to be biased in one way or another. But, when the interests of a particular group are at odds with the interests of the military, a hostile atmosphere could be the product. Here, it must be remembered that these things are rarely personal—most of the time the individuals do not dislike the presenter or the government, they are simply concerned about their business or livelihoods.

In all cases, the best practice is to keep a professional appearance and demeanor, and stick to the facts. The presenter should answer only the questions she/he knows, and jot down the questions she/he does not know with the promise that the participant will be contacted with the answer in a timely manner. Additionally, while it is best to keep the atmosphere light, it is important that an audience is comfortable that their concerns are being taken seriously

C.7 CONCLUSION

By and large, people are either apathetic or fearful of things they do not understand, neither of which is good when it comes to issues involving noise.

On the one hand, the military does not want citizens or installation personnel not caring about issues of noise, because this eliminates the interest that is required to solve problems proactively. On the other hand, fearful individuals tend to overreact and further complicate a situation. The ideal state is one where an informed and concerned military does everything it can to mitigate noise impacts while still performing its Constitutionally-charged mission, and an informed and concerned public makes land use decisions that are compatible with that noise environment.

To that end, the way in which noise contours are presented (and to whom) can go along way toward a state where installations and the public work together to each other's mutual benefit.

Remember: in risk communication, one has successfully conveyed the seriousness of a situation when they have raised the alarm of the Unconcerned, and calmed the Overly-concerned to the rational level of awareness that the particular situation deserves.

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Appendix D
Land Use Planning and Control Techniques

D.1 GENERAL

Several different planning and land use control techniques are available to local governments to ensure that compatible uses are located in and around areas of unique characteristics (such as the lands that border military installations). Some are more specialized than others, but wielded properly, every one of the following tools has the capability to limit the possibility of complaints due to encroachment.

D.2 ZONING

The most common method of land use control is *zoning*, or the partitioning of areas into sections reserved for different purposes. This method is an exercise of the police powers of state and local governments that designates the uses permitted in each parcel of land. It normally consists of a zoning ordinance that delineates the various use districts and a zoning map based on the land use element of the community's comprehensive general plan.

- **Uses of Zoning.** Zoning should be applied fairly and based on a comprehensive plan that considers the total needs of the community along with the specific needs of the installation. For example, it is not acceptable to zone a parcel of land for industrial or warehouse usage simply because it lies within a noise impact area. Such an action could be considered "arbitrary, capricious, or unreasonable" and thus be vulnerable in the event of judicial review; zoning plans must clearly demonstrate that there is a reasonable present or future need for such usage. However, if it can be clearly shown that the proposed zoning is being used constructively to increase the value and productivity of land within noise impacted areas, it is the preferred method of controlling land use.

- **Limitations of Zoning.** Zoning has several limitations that must be considered when using it as a compatibility implementation device. These limitations include the following:

  - <u>Zoning is usually not retroactive.</u> That is, changing a zone for the primary purpose of prohibiting a use that already exists is normally not possible. And even if such a change is successful, the existing uses that have been rendered unlawful must remain as "nonconforming" elements until the owner has had ample time to recoup his/her investment.

  - <u>Zoning is jurisdiction-limited.</u> Installation impacts often span more than one zoning jurisdiction. In these cases, zoning requires the coordination of all involved jurisdictions in order to be effective. Zoning that implements a compatibility plan will often be composed of existing and new zoning districts

within each of the zoning jurisdictions covered by the plan. Further complicating matters, each jurisdiction is likely to have a different base zoning ordinance requiring different actions for implementing the compatibility plan. Also, counties in many states do not have any zoning authority at all, so land use control via zoning in these states stops at the municipal boundary.

- Zoning is **not** permanent. In any jurisdiction, zoning can be changed by the current government body; it is not bound by prior zoning actions. Consequently, even if zoning achieves compatibility, that compatibility is continually pressured by both urban expansion and enterprises that might profit from a favorable zoning change.

- Cumulative zoning can permit incompatible development. Several communities around the country employ "cumulative"-type zoning districts that permit all "higher" uses (such as residential) in "lower" use districts (such as commercial or industrial), thus supporting development that may be incompatible. In these instances, it is necessary to prepare and adopt new or additional zoning districts of the "exclusionary" type (i.e., that clearly specify the uses permitted and exclude all others).

- Zoning Board of Adjustment actions granting variances. Variances to the zoning district of exceptions (e.g., schools or churches) written into the zoning ordinance can also permit development that may be incompatible.

- **Positive Features of Zoning.** The zoning ordinance may be the most attractive land use control to prevent development around installations because it is effective (prohibiting specific development by law) and normally costs the installation nothing.

- **Negative Features of Zoning.** The installation must rely on the municipality's governing body for proper zoning solutions which may entail political struggles beyond the installation's control. Also, the municipality must be wary of "taking land without compensation," which is a citizen's rights issue that is often raised in zoning proceedings.

D.3 OVERLAY DISTRICTS

An overlay district is generally defined as any specially mapped district which is subject to supplementary regulations or requirements for development. Overlay districts, by either adding restrictions to or removing restrictions from the underlying zoning, provide specific provisions designed to address issues unique to a particular geographic area. They are used to curb discordant development in places where a specific resource (cultural, economic, or environmental) is in jeopardy.

The following are some examples of situations that may garner the creation of an overlay district:

- Neighborhood/Historic Area Preservation
- Focused Economic Development – targeted revitalization areas, business parks, etc.
- Natural Resource Protection – watersheds, aquifers, wildlife corridors, etc.
- Infrastructure Protection – airports, military bases, cultural districts, etc.
- Specific Plans – university districts, cultural districts, etc.

The provisions set forth in an overlay district can regulate any number of things from construction materials or styles (to better fit a historical district or provide for noise protection next to an airport), to business types and practices (in order to protect something like a reservoir).

- **Positive Features of Overlay Districts.** Allow great regulatory flexibility to be assigned to a very specific area so that any inconvenience affects the fewest number of people possible. Also, cost the local government and sponsoring party very little to implement.

- **Negative Features of Overlay Districts.** Must be approved by community/city council and is subject to public hearings. Implementation is also subject to local political climate and public perception/attitudes.

D.4 EASEMENTS

Easements can be an effective and permanent form of land use control; in many instances, better than zoning when trying to resolve and installations compatibility issues. Easements are permanent (with the title held by the purchaser until sold or released), work equally well within different jurisdictions, are enforceable through civil courts, and may be acquired often at a fraction of the cost of the land value. Another consideration is that the land is left free for full development with noise-compatible uses.

- **Definition.** An easement is the right of another to part of the total benefits of the real property owner. When dealing with the laws of property in this country, ownership of property includes possession of a series of rights to the use of that property. Certain rights to the property are always retained by the state or the general public (e.g., police power, taxation, eminent domain, escheat, etc.), and certain rights are retained by the neighboring property owners (e.g., the flow of water across land). But, the owner controls the rest of the rights to build, log, mine, etc. Usually when property is acquired, all of the rights are purchased (i.e., in fee simple). However, it is possible to buy only the selected rights that are actually needed in the form of easements. The cost of an easement is determined by the value of those rights to the land owner. If the easement will not adversely affect the owner's contemplated usage or sale of the land, the price will be low; if it does, the price will be higher.

  There are two basic classes of easements: positive and negative. In positive easements, the right to do something with the property (such as build a road) is acquired. In negative easements, the rights are acquired to prevent the owner of the property from doing

something (such as erecting billboards). For issues of noise compatibility, both a positive easement to make noise over the land and the negative easement to prevent the creation of an unprotected noise-sensitive use on the property may need to be acquired to ensure adequate control.

- **Obtaining Easements.** Easements can be obtained in several ways including purchase, condemnation, and dedication. For each easement required, it is wise to include a legal description of the noise that may be created over the property and the classes of uses that may be established or maintained with and without soundproofing.

- **Positive Features of Easements.** Easement purchases are very straightforward transactions and are almost always less expensive than fee-simple purchases. They allow the installation to retain control over adjacent land without the burden of actual ownership, and they are also usable in cases for which development already surrounds the installation.

- **Negative Features of Easements.** There may be difficulty in getting the cooperation necessary to obtain easements, particularly when many land owners are involved. Also, unless otherwise specified, the rights are not automatically transferred upon resale of the land, so future negotiations may be required.

D.5 TRANSFER OF DEVELOPMENT RIGHTS (TDR)

Under the TDR concept, some of the property's developmental rights are transferred to a remote location where they may be used to intensify allowable development. So, for example, lands within an installation's noise-impacted area could be kept in open space or agricultural areas, and their developmental rights for residential uses transferred to more appropriate locations. In this system, land owners are compensated for their rights at market value, and the purchaser either holds the rights or recoups the investment when houses are built and sold using the rights. The TDR approach must be fully coordinated with the community's planning and zoning office, and it may be necessary for the zoning ordinance to be amended so that it permits TDRs. Also, transfers usually must be contained within single zoning jurisdictions.

- **Positive Features of TDRs.** The program itself is inexpensive or cost-free to the installations because it is administered by the local governments, and it may stimulate development in the areas to which the rights are being transferred.

- **Negative Features of TDRs.** One potential problem is record keeping. Because of the complexity of the transactions, it is often difficult to keep track of the principals and the exact number of rights that are sold and bought. Nevertheless, it can be done and this system is currently in place in Harford County, Maryland—the home of Aberdeen Proving Ground—and many others.

D.6 LAND PURCHASE

Fee-simple purchase of noise impacted land is the most positive form of land use control, but it is also the most expensive. It must be kept in mind though that, while the costs may seem excessive on the surface, the net cost may be reduced substantially with either resale for compatible uses or retention and use for a compatible public purpose. As a preventive measure, purchase should be mostly limited to critical locations and to situations where other solutions are not feasible.

- **Positive Features of Land Purchase.** Allows installation complete control over the use of the land including sale at a later date.

- **Negative Features of Land Purchase.** The biggest problem with this method is that the initial cost of acquiring the land may be too great to justify. Additionally, the cost of maintaining the land in the future must be factored into to any cost projections.

D.7 BUILDING CODES

A building code prescribes the basic requirements that regulate the construction of structures. It is adopted by the local governing body to protect the health, safety, and general welfare of the occupants of these structures through the establishment of a set of minimum requirements for fire resistance, strength, ventilation, plumbing, etc. Although codes are not a technique to actually prevent development, if properly conceived they can effectively restrict it near military installations by requiring structures to be constructed to a particular standard of sound transmission.

- **Positive Features of Building Codes.** If development is imminent, utilizing the building code ensures that at the very least new structures will be constructed with a certain level of inherent sound proofing.

- **Negative Features of Building Codes.** Building codes do not prevent or restrict any type of actual land use around an installation.

D.8 SUBDIVISION REGULATION

Subdivision regulations are a means by which local government can ensure that proper lot layout, design, and improvements are included in new residential or commercial developments. These requirements may be anything from dictating the width of the roads to placement of the water and/or sewer systems. Since most local governments require some type of public dedication of open space when approving development plans, the installation may lobby to have a provision added to the subdivision regulations that requires this open space to be located nearest the installation boundary to create a buffer.

- **Positive Features of Subdivision Regulations.** The regulations can be used to judiciously locate areas of open space to create buffers between noise sources and receivers.

- **Negative Features of Subdivision Regulations.** Subdivision regulations are only a way to diminish the impact of noise emanating from an installation; they alone will not prevent development around an installation. Also, depending on the scope of the development plans, the buffers created may not be large enough to adequately cut the noise levels.

D.9 HEALTH CODES

The heath code in a given community establishes the requirements that protect residents from elements that may endanger them such as poor sanitation and inadequate drinking water supplies. Health codes encompass all types of land use but, like building codes, they cannot directly prevent development around military installations. Health codes can, however, protect people from noise impacts if a standard is built into the code that requires a developer to prohibit excessive noise levels in the development or consider other uses that are not noise-sensitive.

- **Positive Features of Health Codes.** The heath code could be used in areas where zoning is either not used or not an option. In most cases, the health code can be made strict enough to disallow residential uses near installations (thus limiting land use to something more compatible such as a manufacturing plant).

- **Negative Features of Health Codes.** The health code, depending on its complexity, is often difficult to administer. Also, the paperwork and field checks required to ensure compliance can be costly to a local government and slow development.

D.10 DISCLOSURE OF NOISE LEVELS

Since noise levels in a community can be measured and recorded, making information about the true noise levels around military installations can sometimes be all it takes to discourage some incompatible uses. These noise levels can be disclosed in several ways including ordinances (or amendments to existing ordinances), including noise levels in the deed, posting noise levels on any sale/lease/rent sign, and initiating voluntary programs among local realtors to provide potential buyers with installation-provided information and noise level/contour maps.

- **Positive Features of Disclosing Noise Levels.** These programs make easily available to the public information that is otherwise difficult to obtain (particularly for those new to the area), making it easier to make an informed choice about where to live.

- **Negative Features of Disclosing Noise Levels.** Simply disclosing noise levels does not ensure that the information will be used, and programs will be required to educate the public and ensure that the information remains current and available. Moreover, these measures could become costly and time-consuming if noise contours were required to be placed on all municipal maps.

D.11 LAND BANKING

Land banking is when a government acquires a substantial fraction of land in a region available for future development for the purpose of implementing a public land use policy. Banking differs from permanent acquisition in that it places the land in a temporary holding status to be turned over for development at a future date.

- **Positive Features of Land Banking.** The two primary arguments in favor of land banking are that it has an anti-inflationary effect in land prices (preventing land speculation), and it will permit more rational patterns of development rather than urban sprawl.

- **Negative Features of Land Banking.** There is not total agreement that land banking is effective. Additionally, beginning a land banking program requires a large expenditure (though this money is recovered when the land is ultimately sold) and there is the possibility that the program can become politically influenced.

D.12 SPECIAL TAX TREATMENT

Whether through full tax exemption, preferential assessment, or deferrals, special tax treatment by a local government can provide owners of land around military installations with incentives to keep land uses on their property compatible with the noise environment.

- **Positive Features of Special Tax Treatment.** Special tax treatments are particularly desirable because there is no cost to the military. Additionally, when existing uses are politically popular (such as farming), support becomes easier to garner. A side benefit is the fact the properties adjacent to the focus of the tax treatment often increase in value (due to lowered supply and the desire of some to locate next to farms or other open space) and that this may actually translate to increased tax revenue for the local government.

- **Negative Features of Special Tax Treatment.** The cost of the program must be absorbed by the local government and it may not be willing to accept a diminished tax revenue stream, even if only temporarily.

D.13 CAPITAL IMPROVEMENTS PROGRAM (CIP)

A capital improvements program (CIP) is a planning tool used by local jurisdictions to prioritize the construction or improvement of needed public facilities (e.g., water and sewer systems, roads, schools, etc.). Since development often follows to where capital improvements have been made, if local governments avoid making capital improvements near military installations, it discourages development by forcing developers to shoulder more costs of the project, sometimes making the return in investment not worthwhile.

- **Positive Features of CIP.** Using the local CIP to discourage development is attractive because it is effectively asking the local government not to do something that is quite expensive, so financially it is not a hard sell.

- **Negative Features of CIP.** The local government may be intent on investing in new capital spending to encourage enlargement of the tax base, and thus may be unwilling to suspend such an initiative at the request of the installation

D.14 DEVELOPMENT LOAN RESTRICTIONS

To fund projects, developers often need to borrow money from lending institutions—if the funds cannot be obtained, the development cannot occur. Consequently, restricting or prohibiting mortgage and/or other loans for certain land uses is a way to control development. For instance, state and local governments could designate areas around military installations (coinciding with certain noise contours) for which banks and other lending institutions are prohibited from making loans.

- **Positive Features of Development Loan Restrictions.** The attractive feature of the program is that it costs nothing for the local government to implement yet still prevents development effectively.

- **Negative Features of Development Loan Restrictions.** These programs usually cannot be implemented immediately because it is quite possible that lending institutions will sue the local government for not allowing then to use their money as they see fit.

D.15 PUBLIC/PRIVATE LEASEBACK

Leaseback is a financial arrangement that can be used in both the public and private sectors whereby land is acquired and controlled, but not necessarily occupied, by the owner. In scenarios involving the prevention of encroachment, ideally the owner of the land can be encouraged to lease the land to a user who will employ it in ways that are compatible with the noise environment. This way, the owner gains stable income from his/her land (leases typically run from 20 to 40 years), but its uses are still checked.

- **Positive Features of Public/Private Leaseback.** Leaseback offers a way for public agencies to acquire land, offset the cost with the income from the lease, and provide for the compatible, continued use of land by others.

- **Negative Features of Public/Private Leaseback.** Owners often have the usual landlord's management problems, and the local government may be denied tax revenue if the land is used by the public sector.

D.16 SALES AGREEMENT

An essential ingredient in transferring real estate into a valuable commodity is a legally binding written sales agreement to establish the terms agreed upon by the buyer and seller. An installation, through sales agreements, can restrict the use of surrounding lands if they own or control them.

- **Positive Features of Sales Agreements.** After signing, the sales agreement is a legally binding contract, and either of the parties can seek legal recourse through the legal system if the contract is broken.

- **Negative Features of Sales Agreements.** Unlike the restrictive covenant, the sales agreement pertains only to the prospective buyer, so terms do not carry over to future sales of the property unless so stated in the contract. In addition, certain areas of agreements and contracts are subject to misrepresentation and fraud.

D.17 DEED RESTRICTIONS/COVENANTS

A deed is a document conveying ownership of land from one party to another, and restrictions called *covenants* can be added to the deed to specify restrictions on the use of the land. These covenants are on top of the restrictions already imposed by the current zoning of the property and in many instances may supersede zoning by prohibiting specified uses that would otherwise be allowed. Restrictive covenants "run with the land;" that is, no matter how often the land is resold, these covenants remain in effect until the specified length of the covenant has expired (usually 20-30 years).

In order to utilize this option, the installation must already own or must acquire the property. Then, when reselling the property, the installation specifies which uses are permitted on the land thereby preventing incompatible uses (such as residential housing) for as long as the restrictions remain in effect.

- **Positive Features of Deed Restrictions/Covenants.** This method is attractive because it allows the installation to retain control over surrounding land uses without needing to continue ownership of the land (thus lessening the tax burden). Deed restrictions are legally enforceable no matter how many times the property is sold.

- **Negative Features of Deed Restrictions/Covenants.** This method requires convincing those in charge that it is necessary to purchase more land than is directly needed, even if it is to be resold shortly thereafter. Also, though rare, there have been cases where courts have declared covenants unreasonably restrictive or impractical and allowed them to be removed by the land owner.

D.18 PURCHASE OF DEVELOPMENT RIGHTS

A title to real property contains several rights, including that of development. So, by purchasing this single right of development, a military installation can effectively prevent incompatible development by taking away anyone else's chance to build on the land; all at a cost that is considerably less than that of purchasing an entire parcel outright. A program of purchasing development rights works best when the development rights of agricultural lands are the primary focus; the installation protects itself and the land remains productive.

- **Positive Features of Purchasing Development Rights.** While development rights are usually the most expensive rights a parcel of land has, purchasing them is still usually less expensive than purchasing the parcel outright and it may yield the same results. Also, there are no ongoing administrative costs once all of the purchases have been made and the military is not responsible for the upkeep of the land.

- **Negative Features of Purchasing Development Rights.** The money required for such programs is usually front-loaded so obtaining the large lump-sums for purchasing the rights may be difficult. Also, if the best use of the land happens to be something like high density residential, the cost of the rights may not be appreciably less than that of fee-simple ownership.

D.19 EMINENT DOMAIN

Eminent domain is a police power that enables governments to condemn private property in order to acquire it (and all its rights) for a public use. When a government exercises eminent domain, it is basically forcing an owner to sell his/her property for just compensation (determined by independent appraisals), regardless of the owner's desires. It is usually implemented as a last resort when property cannot by acquired or controlled by other methods.

- **Positive Features of Eminent Domain.** Like other acquisition methods, eminent domain allows the government to own full rights to the property.

- **Negative Features of Eminent Domain.** Eminent domain has three primary drawbacks. First, since it is based on fair compensation to the owner, it requires basically the same amount of funding as would buying the property on the free market. Second, when the government takes land from unwilling sellers, the proceedings often result in protracted litigation and adverse publicity. Third, it is sometimes difficult to prove that the public benefit of taking the land is great enough to warrant taking it from an individual.

D.20 PURCHASE OPTION

A purchase option is an agreement whereby the seller agrees to hold the property for a specified time and, in turn, the buyer agrees to pay a sum of money as consideration for that offer. At the time the option is granted, no real property ownership rights pass. Instead, the buyer is purchasing the right to buy at a fixed price within a specified period of time and the seller retains the money paid regardless of whether the option is exercised. This option can be used when funds cannot be immediately acquired to purchase this property outright or if more time is needed to explore possibilities such as rezoning.

- **Positive Features of Purchase Options.** As mentioned above, an option can allow the buyer time to locate and secure the funds necessary to make the final purchase.

- **Negative Features of Purchase Options.** This technique requires the expenditure of funds to purchase the option, and that money is lost if the installation is unable to complete the purchase of the property itself.

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Appendix E

FICUN GUIDELINES FOR CONSIDERING NOISE IN LAND USE PLANNING

SLUCM No.	LAND USE	NOISE ZONES AND ADNL LEVELS (dBA)						
		Noise Zone I		Noise Zone II		Noise Zone III		
		0-55	55-65	65-70	70-75	75-80	80-85	85+
10	**RESIDENTIAL**							
11	Household Units	yes	yes*	25[1]	30[1]	no	no	no
12	Group Quarters	yes	yes*	25[1]	30[1]	no	no	no
13	Residential Hotels	yes	yes*	25[1]	30[1]	no	no	no
14	Mobile Home Parks or Courts	yes	yes*	no	no	no	no	no
15	Transient Lodgings	yes	yes*	25[1]	30[1]	35[1]	no	no
16	Other Residential	yes	yes*	25[1]	30[1]	no	no	no
20, 30	**MANUFACTURING**							
21	Food & Kindred Products	yes	yes	yes	yes[2]	yes[3]	yes[4]	no
22	Textile Mill Products	yes	yes	yes	yes[2]	yes[3]	yes[4]	no
23	Apparel/Other Finished Products	yes	yes	yes	yes[2]	yes[3]	yes[4]	no
24	Lumber & Wood Products	yes	yes	yes	yes[2]	yes[3]	yes[4]	no
25	Furniture and Fixtures	yes	yes	yes	yes[2]	yes[3]	yes[4]	no
26	Paper & Allied Products	yes	yes	yes	yes[2]	yes[3]	yes[4]	no
27	Printing, Publishing & Allied Industries	yes	yes	yes	yes[2]	yes[3]	yes[4]	no
28	Chemicals & Allied Products	yes	yes	yes	yes[2]	yes[3]	yes[4]	no
29	Petroleum Refining & Related Industries	yes	yes	yes	yes[2]	yes[3]	yes[4]	no
31	Rubber & Misc Plastic Products - Manufacturing	yes	yes	yes	yes[2]	yes[3]	yes[4]	no
32	Stone, Clay & Glass Products - Manufacturing	yes	yes	yes	yes[2]	yes[3]	yes[4]	no
33	Primary Metal Industries	yes	yes	yes	yes[2]	yes[3]	yes[4]	no
34	Fabricated Metal Products - Manufacturing	yes	yes	yes	yes[2]	yes[3]	yes[4]	no
35	Professional, Scientific & Controls	yes	yes	yes	25	30	no	no
39	Miscellaneous Manufacturing	yes	yes	yes	yes[2]	yes[3]	yes[4]	no
40	**TRANSPORTATION, COMMUNICATION & UTILITIES**							
41	Railroad, Rapid Rail Transit & Street Rail	yes	yes	yes	yes[2]	yes[3]	yes[4]	yes[4]
42	Motor Vehicle Transportation	yes	yes	yes	yes[2]	yes[3]	yes[4]	yes[4]
43	Aircraft Transportation	yes	yes	yes	yes[2]	yes[3]	yes[4]	yes[4]
44	Marine Craft Transportation	yes	yes	yes	yes[2]	yes[3]	yes[4]	yes[4]
45	Highway & Street Right-of-Way	yes	yes	yes	yes[2]	yes[3]	yes[4]	yes[4]
46	Automobile Parking	yes	yes	yes	yes[2]	yes[3]	yes[4]	no
47	Communications	yes	yes	yes	25[5]	30[5]	no	no
48	Utilities	yes	yes	yes	yes[2]	yes[3]	yes[4]	yes[4]
49	Other Transportation, Communications & Utilities	yes	yes	yes	25[5]	30[5]	no	no

SLUCM No.	LAND USE	NOISE ZONES AND ADNL LEVELS (dBA)						
		Noise Zone I		Noise Zone II		Noise Zone III		
		0-55	55-65	65-70	70-75	75-80	80-85	85+
50	**TRADE**							
51	Wholesale Trade	yes	yes	yes	yes[2]	yes[3]	yes[4]	no
52	Retail Building Materials, Hardware/Farm	yes	yes	yes	yes[2]	yes[3]	yes[4]	no
53	Retail - General Merchandise	yes	yes	yes	25	30	no	no
54	Retail - Food	yes	yes	yes	25	30	no	no
55	Retail - Auto, Marine, Aircraft & Parts	yes	yes	yes	25	30	no	no
56	Retail - Apparel & Accessories	yes	yes	yes	25	30	no	no
57	Retail - Furniture Furnishings & Equipment	yes	yes	yes	25	30	no	no
58	Retail - Eating and Drinking Facilities	yes	yes	yes	25	30	no	no
59	Other Retail Trade	yes	yes	yes	25	30	no	no
60	**SERVICES**							
61	Finance, Insurance & Real Estate Services	yes	yes	yes	25	30	no	no
62	Personal Services	yes	yes	yes	25	30	no	no
62.4	Cemeteries [11]	yes	yes	yes	yes[2]	yes[3]	yes[4]	yes[6]
63	Business Services	yes	yes	yes	25	30	no	no
64	Repair Services	yes	yes	yes	yes[2]	yes[3]	yes[4]	no
65	Professional Services	yes	yes	yes	25	30	no	no
65.1	Hospitals, Nursing Homes	yes	yes*	25*	30*	no	no	no
65.1	Other Medical Facilities	yes	yes	yes	25	30	no	no
66	Contract Construction Services	yes	yes	yes	25	30	no	no
67	Government Services	yes	yes*	yes*	25*	30*	no	no
68	Educational Services	yes	yes*	25*	30*	no	no	no
69	Miscellaneous Services	yes	yes	yes	25	30	no	no
70	**CULTURAL, ENTERTAINMENT & RECREATION**							
71	Cultural Activities, Churches	yes	yes*	25*	30*	no	no	no
71.2	Nature Exhibits	yes	yes*	yes*	no	no	no	no
72	Public Assembly	yes	yes	yes	no	no	no	no
72.1	Auditoriums, Concert Halls	yes	yes	25	30	no	no	no
72.11	Outdoor Music Shells, Amphitheaters	yes	yes*	no	no	no	no	no
72.2	Outdoor Sports Arenas, Spectator Sports	yes	yes	yes[7]	yes[7]	no	no	no
73	Amusements	yes	yes	yes	yes	no	no	no
74	Recreational Activities	yes	yes*	yes*	25*	30*	no	no
75	Resorts, Groups & Camps	yes	yes*	yes*	yes*	no	no	no
76	Parks	yes	yes*	yes*	yes*	no	no	no
79	Other Cultural, Entertainment & Recreation	yes	yes*	yes*	yes*	no	no	no

SLUCM No.	LAND USE	NOISE ZONES AND ADNL LEVELS (dBA)						
		Noise Zone I		Noise Zone II		Noise Zone III		
		0-55	55-65	65-70	70-75	75-80	80-85	85+
80	**RESOURCE PRODUCTION & EXTRACTION**							
81	Agriculture (Except Livestock)[11]	yes	yes	yes[8]	yes[9]	yes[10]	yes[10]	yes[10]
81.5 to 81.7	Livestock Farming & Animal Breeding	yes	yes	yes[8]	yes[9]	no	no	no
82	Agriculture Related Activities[11]	yes	yes	yes[8]	yes[9]	yes[10]	yes[10]	yes[10]
83	Forestry Activities & Related Services[11]	yes	yes	yes[8]	yes[9]	yes[10]	yes[10]	yes[10]
84	Fishing Activities & Related Services	yes	yes	yes	yes	yes	yes	yes
85	Mining Activities & Related Services	yes	yes	yes	yes	yes	yes	yes
89	Other Resource Production & Extraction	yes	yes	yes	yes	yes	yes	yes

Legend:

SLUCM	Standard Land Use Coding Manual
Yes	Land use and related structures compatible without restrictions.
No	Land use and related structures are not compatible and should be prohibited.
ADNL	A-weighted day-night sound level
NLR	Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.
Yes[x]	"Yes," but with restrictions. See footnotes.
25, 30, 35	Land use and related structures generally compatible; measures to achieve NLR of 25, 30, or 35 must be incorporated into the design and construction of the structure.
25*, 30*, 35*	Land use generally compatible with NLR; however, measures to achieve an overall NLR do not necessarily solve noise difficulties and additional evaluation is warranted.

Footnotes:

* The designation of these uses as "compatible" in this zone reflects individual Federal agencies' consideration if general cost and feasibility factors as well as past community experiences and program objectives. Localities, when evaluating the application of these guidelines to specific situations, may have different concerns or goals to consider.

(A) Although local conditions may require residential use, it is discouraged in 65-70 ADNL and strongly discouraged in 70-75 ADNL, The absence of viable alternative development options should be determined and an evaluation indication that a demonstrated community need for residential use would not be met if development were prohibited in these zones should be conducted prior to approval.

(B) Where the community determines that residential uses must be allowed, measures to achieve outdoor to indoor NLR of at least 25 dB (in 65-70 ADNL areas) and 30 dB (in 70-75 ADNL areas) should be incorporated into building codes and be considered in individual approvals. Normal construction can be expected to provide a NLR of 20 dB, thus the reduction requirements are often stated as 5, 10, or 15dB over standard construction and normally assume mechanical ventilation and closed windows year round. Additional consideration should be given to modifying NLR levels based on peak noise levels.

(C) NLR criteria will not eliminate outdoor noise problems. However, building location and site planning, design, and use of berms and barriers can help mitigate outdoor noise exposure particularly from ground-level transportation sources. Measures that reduce noise at a site should be used wherever practical in preference to measures that only protect interior spaces.

X[2] Measures to achieve NLR of 25 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise-sensitive areas, or where the normal noise level is low.

X[3] Measures to achieve NLR of 30 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise-sensitive areas, or where the normal noise level is low.

X[4]	Measures to achieve NLR of 35 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise-sensitive areas, or where the normal noise level is low.
X[5]	If noise-sensitive, use indicated NLR; if not, use is compatible.
X[6]	No buildings.
X[7]	Land use compatible provided special sound reinforcement systems are installed.
X[8]	Residential buildings require an NLR of 25.
X[9]	Residential buildings require an NLR of 30.
X[10]	Residential buildings not permitted.
X[11]	In areas with an ADNL greater than 80, land use not recommended. But, if a community decides use is necessary, hearing protection devices should be worn by personnel.

Appendix F
AR 200-1, Operational Noise Section; DODI

F.1 ARMY REGULATION 200-1 NOISE SECTION (2007)

Chapter 14
Operational Noise

14–1. Policy

a. Evaluate and document the impact of noise produced by ongoing and proposed Army actions/activities and minimize annoyance to humans to the extent practicable.

b. Develop installation noise management plans as appropriate.

c. Reduce noise to acceptable levels in on-post noise sensitive locations (for example, medical treatment, education, family housing) through appropriate land use planning and/or architectural and engineering controls.

d. Monitor, record, archive and address operational noise complaints.

e. Develop and procure weapons systems and other military combat equipment (for example, electrical generators, etc.) that produce less noise, when consistent with operational requirements. Measure the noise emitted by all combat equipment and weapons systems to be used in training before deployed to units.

f. Procure commercially manufactured products, or those adapted for general military use that produce less noise, and comply with regulatory noise emissions standards.

g. Acquire property only as a last resort to resolve off-post noise issues.

h. Manage operational noise issues and community relations to maintain sustainable testing and training capabilities and prevent encroachment.

14–2. Legal and other requirements

Property and tort law; Noise Control Act of 1972, Quiet Communities Act of 1978; AR 95–1; AR 210–20; AR 350–19; and applicable State and local laws.

14–3. Major program goals

a. Control operational noise to protect the health and welfare of people, on- and off- post, impacted by all Army-produced noise, including on- and off-post noise sources.

b. Reduce community annoyance from operational noise to the extent feasible, consistent with Army training and materiel testing mission requirements.

c. Actively engage local communities in land use planning in areas subject to high levels of operational noise and a high potential for noise complaints.

14–4. Program requirements

a. Noise descriptors (metrics) appropriate for determination of compatible land use, and assessment procedures will be based on the best available scientific information.

(1) The day-night level (DNL) is the primary descriptor for military noise, except small arms, see table 14–1. The DNL is the time weighted energy average sound level with a 10-decibel (dB) penalty added to the nighttime levels (2200 to 0700 hours). The DNL noise metric may be further defined, as appropriate, by the installation with a specific, designated time period (for example, annual average DNL, average busy month DNL). The typical assessment period over which the noise energy is averaged is 250 days for Active Army installations and 104 days for Army Reserve and National Guard installations. The use of average busy month DNL is appropriate when the OPTEMPO is significantly different during certain peak periods of the year. For future land use planning and encroachment assessment purposes, a reasonable annual growth factor in activity (for example, 10 or 15 percent) may be assumed.

(2) Supplemental metrics, such as single event noise data (for example, Peak, PK 15(met) or CSEL), may be employed where appropriate to provide additional information on the effects of noise from test and training ranges. A-weighted maximum noise levels will be used to assess aviation low level military training routes (MTRs) and/or flight tracks.

(3) The use of average noise levels over a protracted time period generally does not adequately assess the probability of community noise complaints. Assess the risk of noise complaints from large caliber impulsive noise

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resulting from testing and training activities, ex. armor, artillery, mortars and demolition activities, in terms of a single event metric, either peak sound pressure level (PK 15(met)) or C-weighted sound exposure level (CSEL). The metric PK 15(met) accounts for statistical variation in received single event peak noise level that is due to weather. It is the calculated peak noise level, without frequency weighting, expected to be exceeded by 15 percent of all events that might occur. If there are multiple weapon types fired from one location, or multiple firing locations, the single event level used should be the loudest level that occurs at each receiver location.

(4) Assess noise from small arms ranges using a single event metric, either PK 15(met) or A-weighted sound exposure level (ASEL).

(5) Use the land use planning zone (LUPZ) contour to better predict noise impacts when levels of operations at airfields or large caliber weapons ranges are above average.

(6) Use available DOD noise assessment software as the primary means of operational noise assessment.

(7) Prepare noise maps showing noise zones and limits as defined in tables 14–1 and 14–2.

(8) Manage noise-sensitive land uses, such as housing, schools, and medical facilities as being acceptable within the LUPZ and noise zone I, normally not recommended in noise zone II, and not recommended in noise zone III. These noise zones are defined in table 14–1.

(9) Single event noise limits in table 14–2 correspond to areas of low to high risk of noise complaints from large caliber weapons and weapons systems. These should be used to supplement the noise zones defined in table 14–1 for land use decisions. Noise sensitive land uses are discouraged in areas where PK 15(met) is between 115 and 130 dB; medium risk of complaints. Noise sensitive land uses are strongly discouraged in areas equal to or greater than PK 15(met) = 130 dB; high risk of noise complaints. For infrequent noise events, installations should determine if land use compatibility within these areas is necessary for mission protection. In the case of infrequent noise events, such as the detonation of explosives, the installation should communicate with the public.

(10) Transportation and industrial noise will be assessed on a case by case basis using appropriate noise metrics, including U.S. Department of Transportation guidelines.

b. Address issues concerning building vibration and rattle due to weapons blast through the appropriate subject matter experts and legal counsel.

c. Address noise impacts on domestic animals and wildlife, as required, through the study of each species' response or a surrogate response to noise. The noise levels set forth herein apply to humans only and do not apply to domestic animals or wildlife.

Table 14–1
Noise Limits for Noise Zones

Noise zone	Noise limits (dB)	Noise limits (dB)	Noise limits (dB)
	Aviation ADNL	**Impulsive CDNL**	**Small arms — PK 15(met)**
LUPZ	60 - 65	57 - 62	N/A
I	< 65	< 62	<87
II	65 - 75	62 - 70	87 - 104
III	>75	>70	>104

Legend for Table 14-1:
dB=decibel
LUPZ=land use planning zone
ADNL=A-weighted day-night levels
CDNL=C-weighted day-night levels
PK 15(met)=Single event peak level exceeded by 15 percent of events
<=less than
>=greater than
N/A=Not Applicable

Table 14–2
Risk of Noise Complaints by Level of Noise

Risk of Noise complaints	Large caliber weapons noise limits (dB) PK 15(met)
Low	< 115
Medium	115 - 130
High	130 - 140
Risk of physiological damage to unprotected human ears and structural damage claims	> 140

Legend for Table 14-2:
dB = decibel
PK 15(met) = Single event peak level exceeded by 15 percent of events

Notes:
[1] Although local conditions regarding the need for housing may require noise-sensitive land uses in Noise Zone II, on or off post, this type of land use is strongly discouraged. The absence of viable alternative development options should be determined and an evaluation should be conducted locally prior to local approvals indicating that a demonstrated community need for the noise-sensitive land use would not be met if development were prohibited in Noise Zone II.
[2] Where the community determines that these uses must be allowed, measures to achieve an outdoor to indoor noise level reduction (NLR) of at least 25 dB to 30 dB in Noise Zone II, from small arms and aviation noise, should be incorporated into building codes and be in individual approvals. The NLR for communities subject to large caliber weapons and weapons system noise is lacking scientific studies to accomplish the recommended NLR. For this reason it is strongly discouraged that noise-sensitive land uses be allowed in Noise Zone II from large caliber weapons.
[3] Normal permanent construction can be expected to provide a NLR of 20 dB, for aircraft and small arms, thus the reduction requirements are often stated as 5, 10 or 15 dB over standard construction and normally assume mechanical ventilation, upgraded Sound Transmission Class (STC) ratings in windows and doors and closed windows year round. Additional consideration should be given to modifying NLR levels based on peak noise levels or vibrations.
[4] NLR criteria will not eliminate outdoor noise problems. However, building location and site planning, and design and use of berms and barriers, can help mitigate outdoor noise exposure NLR particularly from ground level aircraft sources. Barriers are generally not effective in noise reduction for large arms such as artillery and armor, large explosions, or from high-level aircraft sources.

F.2 DEPARTMENT OF DEFENSE INSTRUCTION ON NOISE PROGRAMS

Department of Defense

INSTRUCTION

NUMBER 4715.13
November 15, 2005

USD(AT&L)

SUBJECT: DoD Noise Program

References: (a) DoD Directive 5134.1, "Under Secretary of Defense for Acquisition, Technology, and Logistics (USD(AT&L))," December 9, 2005
(b) DoD Directive 5124.2, "Under Secretary of Defense for Personnel and Readiness (USD(P&R))," October 31, 1994
(c) DoD Instruction 4165.57, "Air Installations Compatible Use Zones," November 8, 1977
(d) DoD Directive 5000.1, "The Defense Acquisition System," May 12, 2003
(e) through (g), see enclosure 1

1. PURPOSE

Under the authority of reference (a) and in conformance with reference (b), this Instruction establishes policy and assigns responsibilities for a coordinated DoD noise program. It also provides for establishment of a DoD Noise Working Group (DNWG).

2. APPLICABILITY

This Instruction applies to the Office of the Secretary of Defense, the Military Departments, the Chairman of the Joint Chiefs of Staff, the Combatant Commands, the Office of the Inspector General of the Department of Defense, the Defense Agencies, the DoD Field Activities, and all other organizational entities within the Department of Defense (hereafter referred to collectively as the "DoD Components").

3. DEFINITION

Noise. For the purposes of this Instruction, noise is defined as unwanted sound generated from the operation of military weapons or weapons systems (e.g., aircraft, small arms, tank guns, artillery, missiles, bombs, rockets, mortars, and explosives) that affects either people, animals (domestic or wild), or structures on or in areas in proximity of a military installation;

1

occupational noise exposure and underwater sound associated with ship testing and training activities are specifically excluded from this definition.

4. POLICY

The DoD noise program shall:

4.1. Reduce adverse effects from the noise associated with military test and training operations consistent with maintaining military readiness.

4.2. Consider the adverse effects of noise from military weapons or weapons systems on the ability to test, train, and operate weapons systems during the development of Initial Capabilities Documents, Capability Development Documents, Capability Production Documents and Capstone Requirements Documents and throughout the Joint Capabilities Integration and Development System and associated acquisition processes.

4.3. Integrate, without degrading mission capabilities, noise management techniques and principles into installation, operational range, and operating area plans and programs and incorporate into Air Installation Compatible Use Zone and Joint Land Use Study program efforts (reference (c) and DoD Instruction 3030.3 (reference (g)).

4.4. Promote scientific research and the use of sound scientific methods and validated noise data as the basis for and the establishment of noise program guidance.

4.5. Promote the development of initiatives to educate and train DoD military, civilian and contractor personnel, and the public on noise issues.

4.6. Leverage resources to the maximum extent possible by ensuring the coordination of DoD noise program initiatives among the Department of Defense and other Federal Agencies.

4.7. Promote outreach with entities affected by noise generated from the operation of military weapons and weapons systems.

5. RESPONSIBILITIES

5.1. The Under Secretary of Defense for Acquisition, Technology, and Logistics (USD(AT&L)) shall:

5.1.1. Provide policy, guidance, oversight, and representation for the DoD noise program.

5.1.2. Establish noise policy and guidance that fully addresses military readiness considerations and ensures noise impacts are considered in the development, acquisition, and

fielding of weapons and weapons systems, in coordination with the Under Secretary of Defense for Personnel and Readiness and the Director of Operational Test and Evaluation.

5.1.3. Review USD(AT&L) DoD Directives 4165.57 and 5000.1 (references (c) and (d)) and DoD Instruction 4715.9 (reference (e)), and supporting references for consistency, revision, and elimination of duplicative requirements.

5.2. The Deputy Under Secretary of Defense for Installations and Environment (DUSD(I&E)), under the USD(AT&L), shall:

5.2.1. Develop and promulgate goals and objectives for the DoD noise program and establish metrics to evaluate progress toward meeting those goals and objectives.

5.2.2. Develop DoD noise program guidance and establish requirements and priorities for use in DoD Component planning, programming, and budgeting, in consultation with the DoD Components.

5.2.3. Consult with the Military Departments on their various installation compatible land use and noise management programs through the DNWG and the Range Sustainment Working Integrated Product Team process.

5.2.4. Establish, support, and provide guidance to a DNWG that includes representatives from the Military Departments. The DNWG shall:

5.2.4.1. Evaluate and advise the DUSD(I&E) and the DoD Components on noise-related issues that have a bearing on the Department of Defense's ability to carry out its assigned mission requirements.

5.2.4.2. Coordinate and provide recommendations on technical and policy issues concerning noise associated with military testing and training activities and the impacts of such noise.

5.2.4.3. Represent DUSD(I&E) at meetings of the Federal Interagency Committee on Aviation Noise and maintain liaison with other Federal and State Agencies, nongovernmental organizations, professional organizations, educational institutions, and industries having similar interests or responsibilities.

5.3 The Under Secretary of Defense for Personnel and Readiness shall:

5.3.1. Coordinate on all policy and guidance issued by the USD(AT&L) regarding the DoD noise program to ensure the policy and guidance fully address military readiness considerations.

5.3.2. Review DoD Directive 3200.15 (reference (f)) and supporting issuances for consistency, revision, and elimination of duplicative requirements.

5.4 The Director of Operational Test and Evaluation shall coordinate on all policy and guidance issued by USD(AT&L) regarding the DoD noise program to ensure the policy and guidance fully consider impacts on testing and evaluation and the operations of the Major Range and Test Facility Base within the Department.

5.5. The Heads of the DoD Components shall:

5.5.1. Provide management support, resources, and professionally qualified staff sufficient to ensure effective implementation of the DoD noise program at all organizational levels.

5.5.2. Provide representatives to the DNWG.

5.5.3. Analyze current and future test and training needs to support effective planning, programming, budgeting, and execution of DoD noise program requirements.

5.6. The Chairman of the Joint Chiefs of Staff shall ensure the impacts of noise emissions on the ability to train and operate are considered during the Joint Capabilities Integration and Development System process.

6. EFFECTIVE DATE

This Instruction is effective immediately.

NOV 15 2005

Kenneth J. Krieg
Under Secretary of Defense
For Acquisition, Technology, and Logistics

Enclosures - 1
E1. References, continued

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Appendix G
Sample Documents

G.1 SAMPLE NOISE DISCLOSURE AND WAIVER

SAMPLE NOISE DISCLOSURE AND WAIVER

Parcel _____ County _____

Grantor(s) Name _____

_____

Grantor(s) Address _____

_____

LEGAL DESCRIPTION:

In accordance with section _____ of the Land Use Ordinance for _____ County, State of _____, furnish disclosure to the owners and potential owners of the above described property adjacent as follows:

1. The Grantors, their heirs, successors, and assigns acknowledge this disclosure that the described property is situated in an area that may be subjected to conditions resulting from military training at _____. Such conditions include the firing of small and large caliber weapons, the overflight of both fixed-wing and rotary-wing aircraft, the movement of vehicles, the use of generators, and other accepted and customary military training activities. These activities ordinarily and necessarily produce noise, dust, smoke and other conditions that may conflict with Grantors' use of Grantors' property for residential and other purposes, and Grantors hereby acknowledge the existence of _____ activities.

2. Nothing in this disclosure shall grant a right to _____ for ingress or egress upon or across the described property. Nothing in this disclosure shall prohibit or otherwise restrict the Grantors from enforcing or seeking enforcement of statues of regulations of governmental agencies for activities conducted on adjacent properties.

3. This disclosure is appurtenant to all property adjacent to the above described property and shall bind to the heirs, successors, and assigns of Grantors and shall endure for the benefit of the adjoined _____. _____ is hereby expressly granted the right of third party enforcement of the disclosure.

IN WITNESS WHEREOF, the Grantors have executed this disclosure dated this _____ day of _____, 20_____.

_____
Grantor

_____
Grantor

G.2 SAMPLE NOISE EASEMENT

SAMPLE NOISE EASEMENT

Parcel _____ County _____

Grantor(s) Name _____

_____

Grantor(s) Address _____

_____

LEGAL DESCRIPTION:

In accordance with section _____ of the Land Use Ordinance for _____ County, State of _____, approving a permit for residential development on the above described property, and in consideration do such approval, Grantors grant to the owners of all property adjacent to the above described property, a perpetual nonexclusive easement as follows:

1. The Grantors, their heirs, successors, and assigns acknowledge by the granting of this easement that the residential development is situated in an area that may be subjected to conditions resulting from military training at _____. Such conditions include the firing of small and large caliber weapons, the overflight of both fixed-wing and rotary-wing aircraft, the movement of vehicles, the use of generators, and other accepted and customary military training activities. These activities ordinarily and necessarily produce noise, dust, smoke, and other conditions that may conflict with Grantor's use of Grantor's property for residential purposes. Grantors hereby waive all common law rights to object to normal and necessary military training activities legally conducted on adjacent _____ which may conflict with Grantor's use of Grantor's property for residential and other purposes, and Grantors hereby grant an easement to the adjacent _____ for such activities.

2. Nothing in this easement shall grant a right to _____ for ingress or egress upon or across the described property. Nothing in this easement shall prohibit or otherwise restrict the Grantors from enforcing or seeking enforcement of statues of regulations of governmental agencies for activities conducted on adjacent properties.

3. This easement is appurtenant to all property adjacent to the above described property and shall bind to the heirs, successors, and assigns of Grantors and shall endure for the benefit of the adjoined _____. _____ is hereby expressly granted the right of third party enforcement of the easement.

IN WITNESS WHEREOF, the Grantors have executed this easement dated this _____ day of _____, 20_____.

_____
Grantor

_____
Grantor

Appendix H
Glossary of Terms, Acronyms, and Abbreviations

H.1 GLOSSARY OF TERMS

A-Weighted Sound Level – a sound level (in decibels) that has been weighted to correspond with the non-linear sensitivity of the human ear. A-weighting discriminates against the lower frequencies and is used to measure most common military sounds such as transportation and small-arms fire.

Above Ground Level (AGL). Distance of the aircraft above the ground.

Ambient Noise – the background noise that is usually present at a particular location; anything from cars on a highway, to insects in the woods.

Atmospheric Refraction – the bending and/or focusing of sound waves by the varying layers and densities of the earth's atmosphere.

C-Weighted Sound Level – like A-weighting, this is another sound level weighting technique that is used to normalize the low, impulsive sounds to the range of human hearing. It is used when measuring low frequency sound such as those from large arms, demolitions, and sonic booms.

Community – those individuals, organizations, or special interest groups affected by or interested in decisions affecting towns, cities, or unincorporated areas near or adjoining a military installation, and officials of local, state, and Federal governments, and Native American tribal councils responsible for the decision making and administration of programs affecting those communities.

Day-Night Average Sound Level (DNL) – the 24-hour average frequency-weighted sound level, in decibels, from midnight to midnight, obtained after the addition of 10 decibel "penalties" to sound levels between midnight and 7 a.m. and 10 p.m. to midnight (0000 to 0700 hours and 2200 to 2400 hours). A-weighting (ADNL) is understood unless otherwise specified, but C-weighting (CDNL) is also common. This average is calculated over a "year," or about 250 training days.

Decibels (dB) – a logarithmic sound pressure unit of measure.

Encroachment – use or development of the land around a military installation that is incompatible with the operations of that installation.

Equivalent-continuous Sound Level (LEQ) – the level of a constant sound which, in a given situation and time period, has the same energy as does a time varying sound. For noise sources which are not in continuous operation, the Equivalent-continuous sound level may be obtained

by summing individual sound exposure level (SEL) values and normalizing them over the appropriate time period.

Frequency – the number of complete oscillation cycles per unit of time. The unit of frequency is the Hertz.

Frequency Weighting – the process of factoring in certain frequencies more or less heavily in order to bring the sound measurement more in line with the characteristics of the receiver (and thus make the numbers more meaningful to the task at hand). Example: A- or C-weighting to specifically parallel the sensitivity of the human ear.

Ground Track Distance. The distance between receiver and the point on the Earth at which the aircraft is directly overhead.

Hertz – the unit of frequency equal to once cycle per second.

Impulse (or Impulsive) Noise – noise of short duration (typically less than one second), high intensity, abrupt onset and rapid decay, and often rapidly changing spectral composition. Impulsive noise is characteristically associated with such sources as explosions, impacts, the discharge of forearms, the passage of supersonic aircraft (creating sonic booms), and many industrial processes.

Large Arms – conventional military weapons 20 millimeters or greater in diameter.

Land Use Planning Zone (LUPZ) – This zone is at the upper end of the NZ I and is defined by a CDNL of 57-62 or an ADNL of 60-65. It accounts for seasonal variability in operations (or several unusually busy days during certain times of the year). Showing the LUPZ creates an added buffer layer to encroachment and signals planners that encroachment into this area is the beginning of where complaints may become an issue.

Noise – defined as any unwanted sound that is loud, unpleasant, unexpected, or undesired.

Noise Exposure – the cumulative acoustic stimulation reaching the ear of a person over a specified period of time (e.g., a work shift, a day, of a lifetime).

Noise Level Reduction – the difference, in decibels, between the sound level outside a building and the sound level inside a designated room in the building (usually A-weighted). The NLR is dependent upon the transmission loss characteristics of the building surfaces exposed to an exterior noise source, the particular noise characteristics of the exterior noise source, and the acoustic properties if the designated room in the building.

Noise Zone III (NZ III) – the area around a noise source in which the C-weighted day-night sound level (CDNL) is greater than 70 dB, the A-weighted day-night level (ADNL) is greater than 75 dB, or the PK15(met) is greater than 104 dB. The noise level within NZ III is considered so severe that noise sensitive activities should not be conducted therein.

Noise Zone II (NZ II) – the area around a noise source in which the C-weighted day-night level (CDNL) is 62-70 dB, the A-weighted day-night level (ADNL) is 65-75 dB, or the PK15(met) is 87-104 dB. The noise level within NZ II is considered significant and use of this land should normally be limited to activities such as industrial, manufacturing, transportation, and resource production.

Noise Zone I (NZ I) – included all areas around a noise source in which the C-weighted day-night sound level (CDNL) is less than 62 dB, the A-weighted day-night level (ADNL) is less than 65 dB, or the PK15(met) is less than 87 dB. This area is usually suited for all types of land use activities.

PK15(met) – peak sound level, without frequency weighting and accounting for the statistical variation cause by weather, expected to be exceeded by 15 percent of all events that might occur. A PK15(met) level of greater than 130 dB has a high risk of complaints, 115-130 dB has a moderate risk of complaints, and below 115 dB has a low risk of complaints.

Propagation – the process by which sound travels through space or material; may be affected by such things as weather, terrain, and barriers.

Slant Distance. The line-of-sight distance between the receiver and the aircraft. The slant distance is the hypotenuse of the triangle represented by the altitude of the aircraft and the distance between the receiver and the aircraft's ground track distance.

Small Arms – conventional military weapons less than 20 millimeters in diameter.

Sound Exposure Level (SEL) – the total energy of a sound event normalized to a specific amount of time (e.g., one second) so that sounds of different durations may be compared directly.

Sound Level Meter – an instrument consisting of an amplifier, microphone, and a graduated readout that provides a direct reading of the sound pressure level at a particular location. Sound may be measured in a variety of metrics (e.g., ADNL, CDNL, Peak, SEL, etc.) and they must satisfy the requirements of the American National Standards Institute (ANSI) Standard for Sound Level Meters (S1.4-1983).

Unweighted Peak Sound Level – the peak, single event sound level without weighting, without taking into account berms or other attenuation, and without any particular certainty.

H.2 GLOSSARY OF ACRONYMS AND ABBREVIATIONS

A

AAF	Army Airfield
ACUB	Army Compatible Use Buffer
ADNL	A-Weighted Day-Night Average Sound Level
ANSI	American National Standards Institute
AR	Army Regulation
ARNG	Army National Guard

ARTEP	Army Training and Evaluation Program

B

BAAF	Bradshaw Army Airfield

C

CALFEX	Combined Arms Live Fire Exercise
CDNL	C-Weighted Day-Night Average Sound Level
CHABA	National Academy of Sciences Committee on Hearing, Bioacoustics, and Biomechanics

D

DA	Department of the Army
dB	Decibel(s)
dBA	Decibels, A-Weighted
dBC	Decibels, C-Weighted
dBP	Decibels, Unweighted Peak
DMR	Dillingham Military Reservation
DNL	Day-Night Average Sound Level
DOD	Department of Defense
DODI	Department of Defense Instruction

E

EA	Environmental Assessment
EIS	Environmental Impact Statement
EJ	Environmental Justice
ENMP	Environmental Noise Management Plan
EPA	Environmental Protection Agency
ERG	Explosives Research Group

F

FAA	Federal Aviation Administration
FICUN	Federal Interagency Committee on Urban Noise
FY	Fiscal Year

G

GIS	Geographic Information Systems
GTA	Grow the Army

H

Hz	Hertz

I

IONMP	Installation Operational Noise Management Plan

IASC	International Air Services Commission

J

JLUS	Joint Land Use Study

K

KTA	Kahuku Training Area
KLOA	Kawailoa Training Area

L

LEQ	Equivalent-continuous Sound Level
LUPZ	Land Use Planning Zone

M

MMR	Makua Military Reservation
MOA	Military Operations Area
MSL	Mean Sea Level

N

NLR	Noise Level Reduction
NOE	Nap of the Earth
NZ	Noise Zone
NZ I	Noise Zone I
NZ II	Noise Zone II
NZ III	Noise Zone III

O

ONMP	Operational Noise Management Program

P

PAO	Public Affairs Office
PTA	Pohakuloa Training Area
PX	Post Exchange

Q

None

R

RCI	Residential Communities Initiative
ROD	Record of Decision

S

SARNAM	Small Arms Range Noise Assessment Model
SBER	Schofield Barracks East Range
SBMR	Schofield Barracks Military Reservation
SEL	Sound Exposure Level

SONMP	Statewide Operational Noise Management Plan
SOP	Standard Operating Procedure

T

TDR	Transfer of Development Rights
TES	Threatened and Endangered Species
TM	Technical Manual

U

USACERL	U.S. Army Construction Engineering Research Laboratories
USARPAC	U.S. Army Pacific
USAPHC	U.S. Army Public Health Command
USAF	U.S. Air Force
USAG-HI	U.S. Army Garrison, Hawai'i
USARHAW	U.S. Army Hawai`i
USASCH	U.S. Army Support Command, Hawai`i
USC	U.S. Code
USGS	U.S. Geological Service

V, W, X, Y, Z

None

Appendix I
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