Department of the Army

Joint Base Lewis-McChord, Washington

Draft Environmental Assessment

Noise Assessment for Test Launches of the Reduced Range Practice Rocket (RRPR) at Joint Base Lewis McChord, Washington

July 2015

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1.0 PURPOSE AND NEED FOR ACTION

1.1 Introduction

The 17th Field Artillery Brigade is currently stationed at Joint Base Lewis-McChord (JBLM), Washington. The primary mission of the 17th Field Artillery Brigade is to provide reinforcing field artillery rocket and missile fires in support of maneuver Brigade Combat Teams and primary support to Combat Support/Combat Service Support forces. Part of this mission includes the training and operation readiness of a technologically advanced force, including the specialized training of field artillery battalions in the high mobility artillery rocket system (HIMARS).

HIMARS is a light-weight multiple launch rocket system (MLRS) that is mounted on a five-ton medium tactical vehicle (Figures 1-1 and 1-2). The HIMARS is transportable on a C-130 aircraft and can be ready to operate within 15 minutes of landing. Its use meets the Army's need for a lighter weight, easily deployable MLRS that can provide lethal, long-range fires at the beginning of a conflict. The HIMARS can fire either six MLRS rockets or one Army Tactical Missile, and has a self-loading capability. The weight of the HIMARS vehicle when loaded with the launcher and six rockets is approximately 24,000 pounds.

Currently, two 17th Field Artillery Brigade HIMARS battalions, the 5th Battalion, 3rd Field Artillery (FA) Regiment, and the 1st Battalion, 94th FA Regiment, conduct HIMARS training at Yakima Training Center (YTC). The battalions must certify HIMARS launch procedures every six months. To maintain required training guidance, twice a year the two battalions travel to YTC at a cost of approximately $227,500 per battalion per trip to YTC. For training purposes, non-explosive reduced range practice rockets (RRPRs) are launched from the HIMARS.

In 2009, a draft Environmental Assessment (EA) was prepared by the Army to conduct long-term HIMARS live fire training at JBLM and YTC using RRPRs. The draft EA was released for public review in September 2009. During the public review process, the communities surrounding JBLM expressed concerns about potentially significant adverse effects of noise on sensitive receptors, historic buildings, fish, and animals, including domestic livestock. Due to these concerns, the Army decided to not finalize the EA. The long-term HIMARS RRPR live-fire training at YTC was incorporated into the 2010 *Grow the Army* Final Programmatic Environmental Impact Statement and Record of Decision. In 2014, the noise model for launching RRPRs at JBLM was updated, resulting in different noise contours. Based on the noise concerns from the surrounding community and the new noise modeling results, the Army is proposing to conduct a number of RRPR test launches at JBLM to collect noise data at various locations on and off the installation.

This EA is prepared in accordance with the National Environmental Policy Act (NEPA) of 1969 (42 USC 4321-4370e), Sec. 102(C) to inform decision-makers and the public of likely environmental consequences of the proposed Army action. It evaluates the environmental, cultural and social effects of the proposed noise assessment of RRPR test launches at JBLM.

Figure 1-1. High Mobility Artillery Rocket System (HIMARS)

Figure 1-2. HIMARS Rocket Launch

1.2 Purpose and Need

Noise from Army training is a significant concern for JBLM and the surrounding communities. The primary purpose of the proposed action is to obtain noise data regarding launching of RRPRs at JBLM. The secondary purpose of this action is to inform the public of the rocket test launch noise assessment. The proposed noise assessment is needed for the Army to understand potential impacts of HIMARS firing of RRPRs to the surrounding community, and to promote good decision making based on best available science. The noise assessment will also allow the Army to receive feed-back from the community regarding launching of RRPRs before a decision is made on the potential for HIMARS training including launching of RRPRs at JBLM. Without the noise assessment, decisions regarding the significance of potential HIMARS firing of RRPRs at JBLM will be based on noise models only. Although modeling is a valuable tool in determining the potential effects of an action, the Army believes that incorporating actual data and feedback from the community is important for assessing potential impacts, and for future planning.

1.3 Scope of the Analysis

This EA presents an analysis of environmental effects associated with the test launch of RRPRs at JBLM. The document analyzes direct effects (those caused by the proposed action and occurring at the same time and place) and indirect effects (those caused by the proposed action and occurring later in time or farther removed in distance). The potential for cumulative effects (effects resulting from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions) is also addressed. Conservation measures to avoid, minimize, rectify, reduce, or compensate for impacts are also identified and evaluated in the EA.

Any proposal to conduct long-term firing of HIMARS RRPRs at JBLM was not considered as either an indirect effect nor a cumulative effect of the proposed action. The long-term firing of HIMARS RRPRs at JBLM is not an action that will occur ‘later in time’, nor should it be considered a ‘future action’ because there is no plan to revise the mission of the 17th Field Artillery Brigade at this time. The noise assessment is strictly to collect noise level data resulting from test firing of RRPRs, and to have a forum for community feedback. Depending upon information provided within the noise assessment, the Army may prepare a future NEPA document regarding long-term training of HIMARS at JBLM. Any future NEPA documents regarding long-term training of HIMARS at JBLM would include information obtained by the noise assessment, and would evaluate direct, indirect, and cumulative impacts of that potential action.

1.4 Interrelationships, Cooperating Agencies, and Consultation Requirements

The Army will cooperate with other federal, state, and local agencies, American Indian tribes, and the public during development of this EA. The Army has previously coordinated with all the stakeholders with regard to HIMARS firing of RRPRs at JBLM. The Army met with the Nisqually Indian Tribe in September 2008 to describe then proposed training at JBLM. Members of the Yakama Nation and Nisqually Indian Tribe also observed HIMARS rocket launches at YTC in February 2009. The Army has continued to involve the Nisqually Indian Tribe, as well as all other stakeholders through the EA process. In May 2015, the Army met with the Nisqually Indian Tribe to present the proposed noise assessment including the data collection.

1.4.1 Endangered Species Act

The Endangered Species Act (ESA) (16 U.S.C. §1531-1544), Section 7(a) requires that Federal agencies consult with the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS), as appropriate, to ensure that proposed actions are not likely to jeopardize the continued existence of endangered or threatened species or to adversely modify or destroy their critical habitats. The Army will coordinate with NMFS and USFWS to ensure the protection of those threatened and endangered species under their respective jurisdictions and to anticipate potential negative effects that may result from the project.

1.4.2 National Historic Preservation Act

Under Section 106 of the National Historic Preservation Act of 1966 (NHPA), Federal agencies are required to consider the effects of proposed Federal undertakings or actions on properties (such as archaeological sites, buildings, structures, or objects) included in or eligible for inclusion in the National Register of Historic Places and consult with State Historic Preservation Officer (SHPO) and Tribes. In 2008, the Army consulted with the Washington SHPO, and evaluated likely impacts to buildings, structures, and objects that are eligible for the National Register of Historic Places which may occur as a result of then proposed long-term HIMARS rocket firing. Section 106 consultation was completed for the 2009 project to conduct long-term HIMARS live fire training at JBLM and YTC using RRPRs. For the proposed noise assessment, the Army will re-initiate consultation with SHPO. The Army will also continue to consult with American Indian tribes about potential effects to properties of traditional cultural and religious significance.

1.4.3 Environmental Justice

The Army is concerned about issues associated with Environmental Justice, especially as they relate to the potential effects of RRPR test firing on the Nisqually Indian Reservation and surrounding communities.. The Army's concerns regarding potential impacts of noise and environmental justice is a major reason why the Army proposes to collect data on the noise impact of RRPR firing at JBLM.

The Nisqually Reservation is the closest community to the proposed RRPR test launch and may be affected by the 3-day noise assessment. Based on the noise model, the majority of the Reservation is outside the elevated noise levels predicted for the test. With the permission from the Nisqually Indian Tribe, noise measurements will be taken from locations within the Reservation boundary to document the noise impacts to the Reservation. The surrounding community may or may not grant permission for noise monitoring independently of the Nisqually Tribe, if requested of the community by JBLM. The Nisqually Indian Tribe will also be provided with the same contact information as the local community, so they can contact JBLM to report noise impacts.

1.4.4 Protection of Children

The Army is concerned regarding potential impacts to children associated with noise from RRPR launching. The Army believes that a noise assessment to collect data must be prepared to ensure

that the Army is utilizing the best available science, along with civilian input and feedback, to facilitate good decision-making. The protection of children is primarily focused on schools within the vicinity of the noise boundary of the RRPR test firing. With permission, the Army proposes to set up noise monitors at schools within the proposed action area. In addition, schools will also be provided in advance with the phone number to report noise disturbance and/or concerns regarding noise impacts.

1.4.5 Public Involvement

The NEPA emphasizes public involvement in government actions affecting the natural and human environment by requiring that the benefits and risks associated with the proposed actions be assessed and publicly disclosed. In accordance with NEPA public involvement requirements, opportunities will be presented for the public to provide written comments on potentially affected resources, environmental issues to be considered, and the agency's approach to the analysis. All persons who have a potential interest in the proposed action, including minority, low-income, and American Indian groups, are urged to participate in the JBLM's environmental impact analysis process conducted under NEPA. The public comment period for the Draft EA will be 27 July 2015 through 25 August 2015.

If the EA results in a Finding of No Significant Impact (FNSI), the FNSI would be made available to the public prior to initiation of the Proposed Action, in accordance with 40 CFR 1506.6. The distribution of the FNSI would occur at least 30 days prior to initiation of the Proposed Action, with copies sent to any agencies, organizations, and individuals who have expressed interest in the project.

2.0 DESCRIPTION OF ALTERNATIVES CONSIDERED

Two alternatives were considered as part of this action: no action alternative and the proposed action.

2.1 No Action Alternative

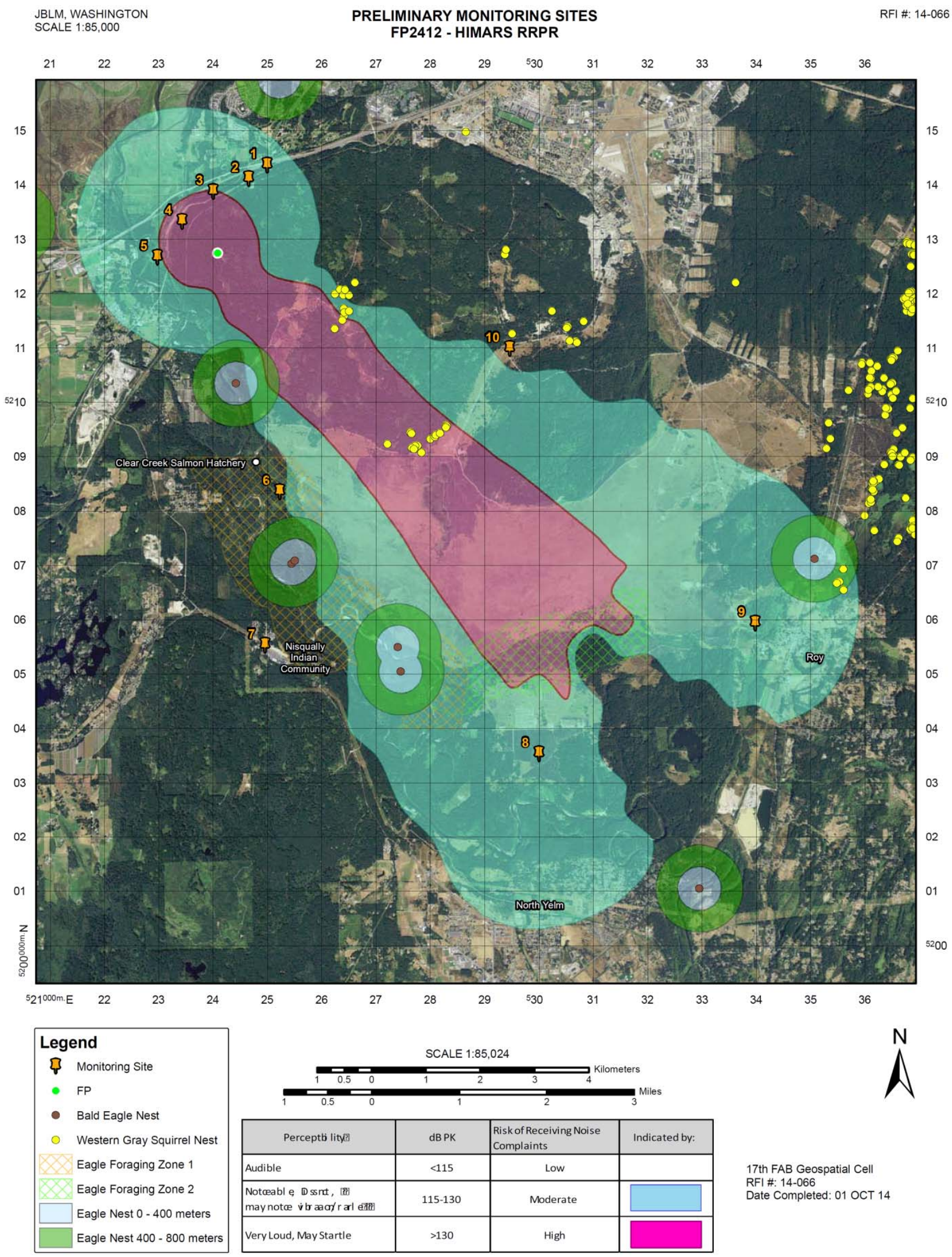
Under the no action alternative, no noise assessment would be conducted at JBLM. The battalions would continue to engage in the types of HIMARS training that they are currently conducting on JBLM training lands, including maneuver training in training areas and weapons training at designated firing ranges. No live-firing of HIMARS would occur at JBLM under the no action alternative. Battalions, however, would continue to conduct live-fire HIMARS activities at YTC.

2.2 Proposed Action - RRPR Test Launch Noise Assessment at JBLM

The proposed RRPR test launches will allow the Army to conduct noise monitoring at JBLM and in surrounding communities. The noise assessment would measure noise levels and determine the noise hazard radius during the firing of RRPRs at the installation boundary, as well as outside the installation. The proposed noise assessment would occur at JBLM in the winter. Testing would occur on three days to get a diverse set of data under variety of weather/atmospheric conditions (based on cloud cover/winds/etc). The noise assessment would utilize approximately ten noise monitors placed at various locations on and off the installation including the sensitive receptors on the Nisqually Reservation and neighboring communities (Table 2-1; Figure 2-1). The exact monitoring locations would be determined by the Army and stakeholder input. HIMARS battalions would fire up to nine (9) RRPRs a day over 3-days and take average noise readings over those days.

Table 2-1. Potential Noise Monitoring Locations

Location of Monitoring Station	Meters from Launch Site	Meters Perpendicular to Trajectory
1. Eagle Pride Golf Course	1,830	None - behind
2. Mounts Rd area 252 Degrees 10T ET 524708 5213967	1,400	None - behind
3. Near FP 225 degrees 10T ET 524098 5213812	1,000	None - behind
4. Near FP 180 degrees 10T ET 523387 513469	1,000	None - behind launch site
5. Wa-He-Kut School	1,495	None - behind launch site
6. Clear Creek Hatchery	9,941	1,767
7. Nisqually Indian Tribal Office	8,110	None - past perpendicular
8. Marion DZ	10,500	None - past perpendicular
9. Mortor FP 13	11,640	None - past perpendicular
10. Intersection at Range 62 10T ET 529407 5211051	6,210	3,800



Perceptibility	dB PK	Risk of Receiving Noise Complaints	Indicated by:
Audible	<115	Low	
Noticeable, Dissonant, may notice vibration/rattle	115-130	Moderate	
Very Loud, May Startle	>130	High	

Figure 2-1. Potential Monitoring Locations for Noise Assessment

Monitoring data from the proposed noise assessment would allow the Army to make a subsequent determination of significance, using the same criteria and guidelines presented in the effects analysis.

2.2.1 RRPR Test-Fire Launching

HIMARS battalions would fire nine RRPRs a day, over a three-day period to conduct the proposed noise assessment (total of up to 27 rockets). RRPRs would be launched from the Hayes Hill launch site (Training Area 4) to the Artillery Impact Area (AIA) (Figures 2-2 and 2-3). Hayes Hill is approximately 0.70 miles south of the Interstate 5 (I-5). As shown in Figure 2-3, RRPRs would be launched in the opposite direction as I-5.

The reduced range of the RRPRs (approximately 5 to 9 miles) makes them suitable for use on small firing ranges at firing points normally reserved for artillery battalions. The RRPRs are blunt-nose, high-drag rockets that are **non-explosive on impact**. The flight of each rocket would be approximately 5 to 6 seconds in duration. Rockets go supersonic within 1 second of launch and remain supersonic for approximately 3.7 miles. A sonic boom may be created, with noise levels potentially greater than 140 decibels directly under the flight path of the rocket. The rocket would fly approximately 1,300 feet above the ground, and the rocket propulsion would be expended 2 to 3 seconds after ignition, leaving an empty, inert tube for impact. Because the rocket is non-explosive, no impact crater would be produced where the rocket lands. The residue of spent rockets would include solid scrap materials, primarily steel casing and aluminum skins.

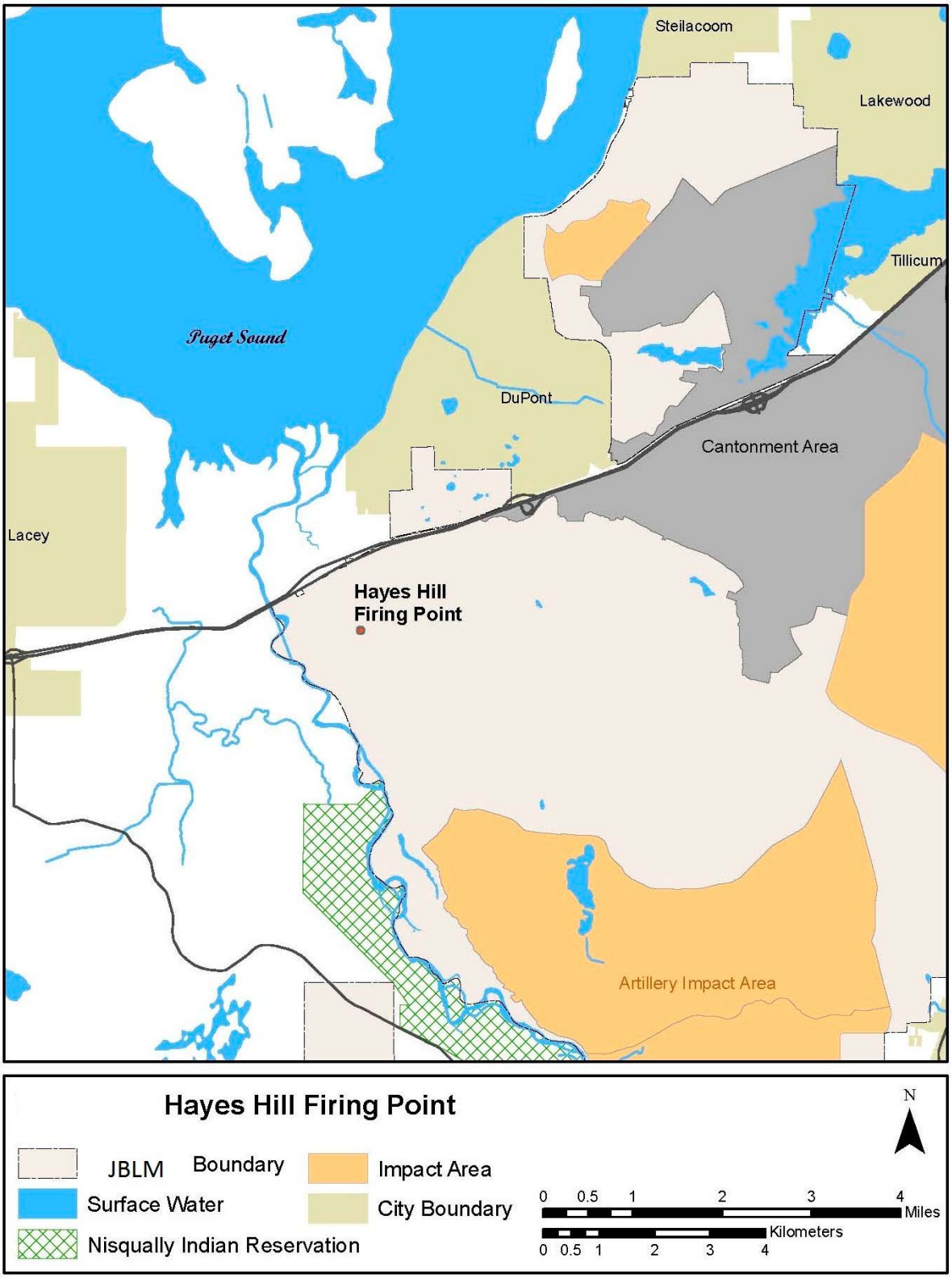

Steilacoom
Lakewood
Tillicum
Puget Sound
DuPont
Cantonment Area
Lacey
Hayes Hill
Firing Point
Artillery Impact Area
Hayes Hill Firing Point
N
JBLM Boundary
Impact Area
Surface Water
City Boundary
Nisqually Indian Reservation
0 0.5 1 2 3 4 Miles
0 0.5 1 2 3 4 Kilometers

Figure 2-2.

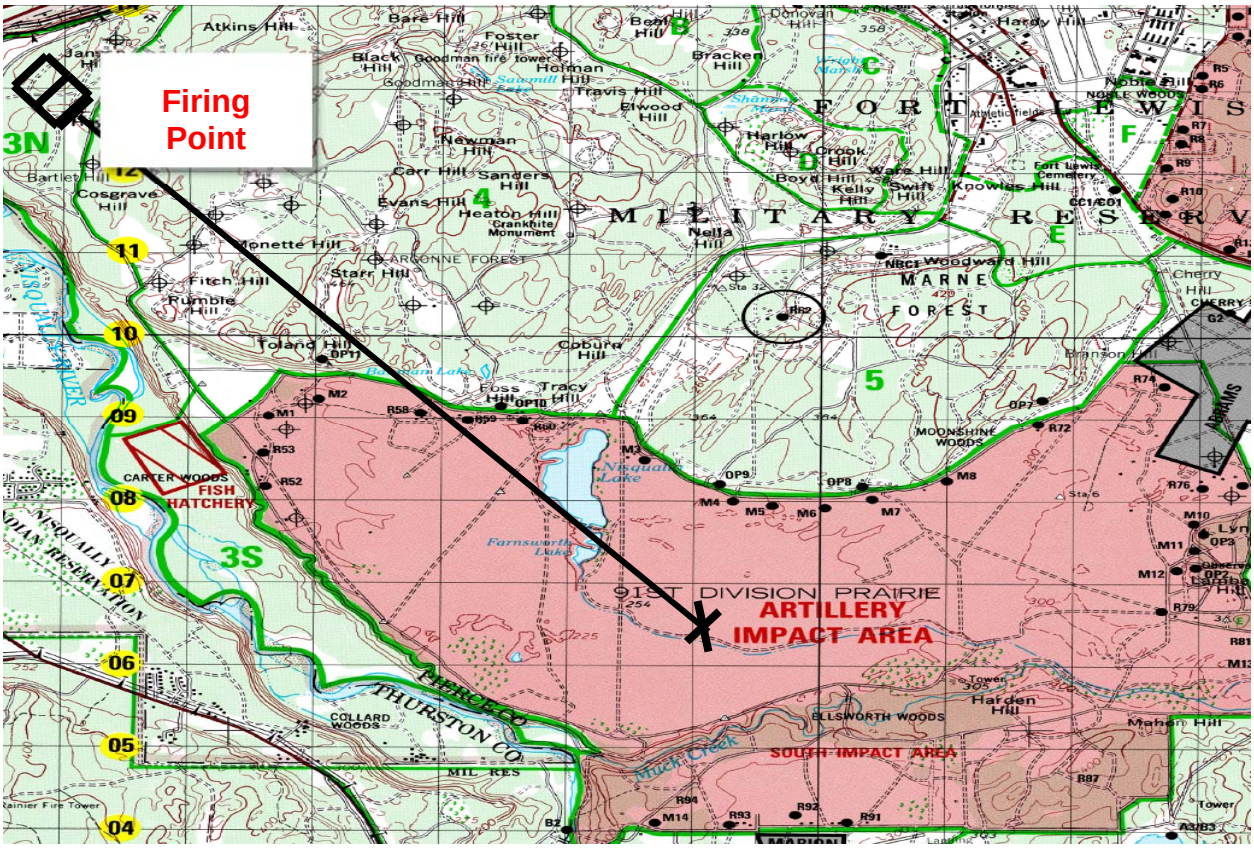


Figure 2-3. HIMARS Launch and Landing Location

2.2.2 RRPR Trajectory Clearing

Firing of RRPRs produces a backblast at ground level, creating a fire danger zone approximately 30 meters directly behind the firing point of the rocket. This area would be cleared of trees to reduce the forest/brush/grass fire hazard and to keep the rocket trajectory path clear of obstacles. Approximately one acre of trees would be harvested from Hayes Hill to provide trajectory clearance for RRPR firing (Figure 2-4, refer to inner footprint). Trees would be cleared prior to initiating the RRPR test launch, and harvested using a feller buncher (a machine that cuts trees in place and then stacks them). The logs would then be removed from the site on skidders. No further training area adjustments would be required for the RRPR test launch noise assessment.

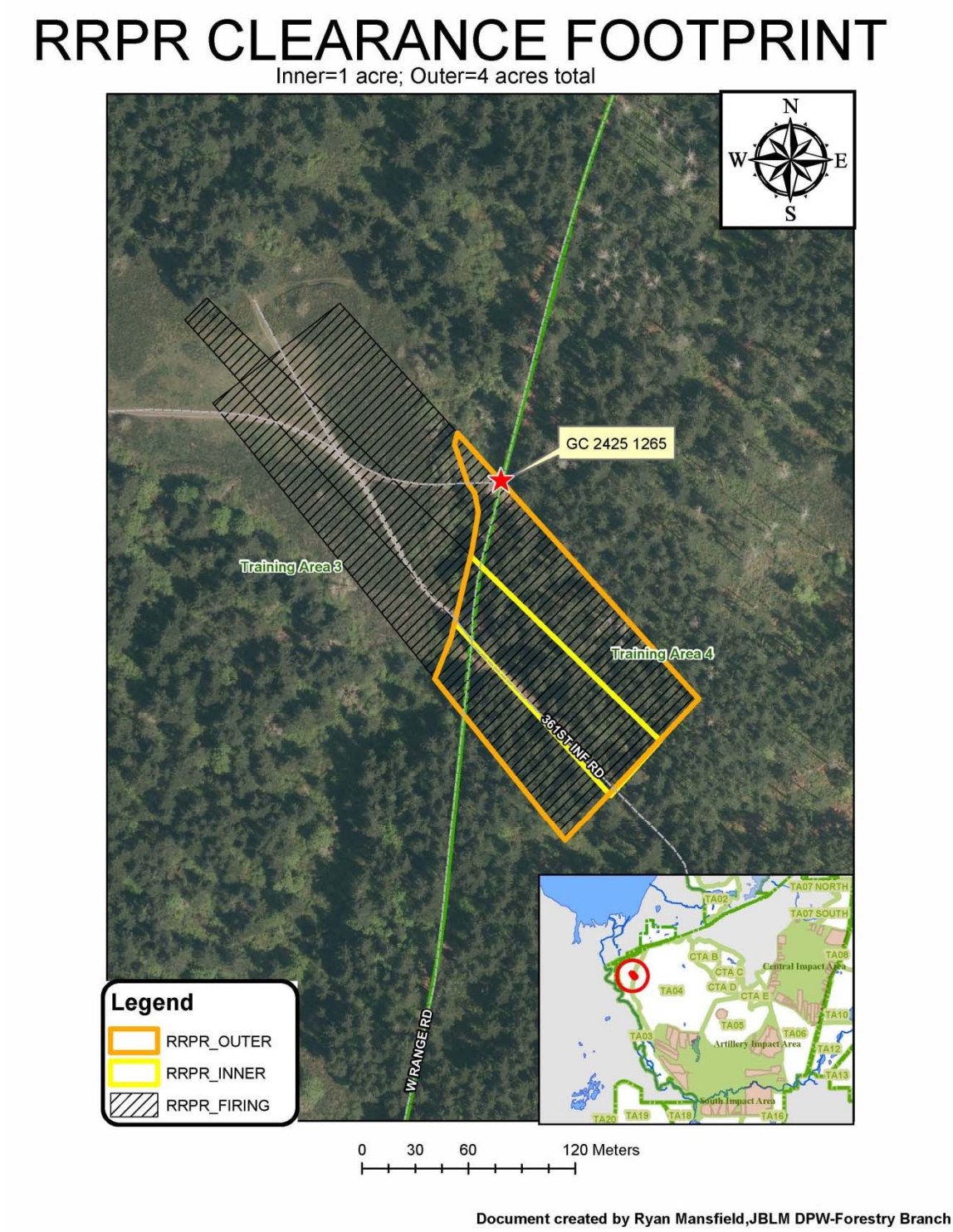


Figure 2-4. Area to be Cleared for the Trajectory Clearance

2.3 Conservation Measures

This EA is based on the assumption that ongoing resource protection and conservation measures at JBLM will continue to be implemented, as they are documented as policy in various regulations and management plans. The protection measures help to mitigate many of the potential adverse effects associated with the proposed tests. Ongoing protection measures include, but are not limited to, fire management programs and procedures, the dig permit program, refueling buffers around aquatic habitats and wetlands, restrictions on certain types of training within land use zones or other areas that are managed to protect sensitive resources, seasonal restrictions on certain types of training to protect sensitive species, and restrictions on nighttime firing of certain weapons. Training under the Proposed Action would conform to the JBLM Integrated Natural Resource Management Plan and the JBLM Cultural Resources Management Plan, which detail resource management policies on the installation.

The following measures are proposed as additional mitigation for adverse effects to the natural environment under the Proposed Action. These additional measures would apply to noise-related effects to the surrounding communities and to sensitive fish and wildlife.

- Do not conduct the test rocket fires during late nighttime hours, or on holidays. The time window for the first firing event would be 9:00 A.M. to 6:00 P.M., with the window for subsequent events adjusted as monitoring data warrants (but not earlier than 7:00 A.M. or later than 10:00 P.M.).
- Conduct test launch in the winter months to avoid nesting season impacts.
- Notify Nisqually tribal officials, city and county law enforcement agencies, 911 call centers, local school officials, and the news media prior to the first firing event.
- Monitor noise levels during all firing events. If the noise assessment documents ‘significant’ noise levels in a day, all RRPR firing would be discontinued immediately. To determine significance, the following noise monitoring criteria would be used:
    - Cessation of operation will be considered if noise levels from the test launch exceed an average of 130 dBP for a day (average noise levels of nine rockets) at the monitoring station beyond the JBLM boundary, any factors that could potentially stop the test will be taken into consideration and the decision will be made by the Installation Commander and 17th Field Artillery Brigade Commander.

2.4 Information on JBLM Noise Complaint Program

JBLM has established policies for publishing notices regarding training, particularly training events that may cause community concern (detailed in Army 2014). A program operated by the JBLM Public Affairs Office is established to respond to noise complaints. People may register noise complaints by calling 253-967-0146 (Community Relations Staff), or 253-967-0852 (Noise Complaint Hotline). Each noise complaint is routed to the Public Affairs Office and recorded on a Noise Complaint Questionnaire form. The Public Affairs Office investigates complaints immediately and responds to each complainant The Public Affairs Office asks the complainant questions, and tries to obtain insight into why the complaint was generated.

The Public Affairs Office maintains a log of all noise complaints that include the location, date, time, and cause of the complaint. From 1994 to 2014, JBLM has averaged 134 noise complaints per year. The number of complaints has ranged from a high of 495 complaints in 1998 to a low of 14 in 2006. The majority of these complaints result from artillery training, with the remainder from aircraft missions (Army 2014). Additionally, the majority of complaints originate from areas south and west of JBLM (Yelm, Roy, Tumwater, Olympia, Lacey, and Rainier).

3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This section describes the existing environmental conditions at JBLM and surrounding area, as they relate to the potential environmental consequences anticipated with the test launch of RRPRs at JBLM to conduct noise monitoring.

An environmental effect, or impact, is defined as a modification in the existing environment brought about by the Army's action; these impacts are described as direct or indirect. The Council on Environmental Quality (CEQ) guideline 40 CFR 1508.8 describes direct impacts to be those which are caused by the action and occur at the same time and place. The CEQ regulations define indirect impacts as those that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect impacts may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems. Cumulative impacts are those that result from the incremental impacts of an action added to other past, present, and reasonably foreseeable actions, regardless of who is responsible for such actions.

3.1 Land Use

Major land uses within the 90,000+ acre joint base include, two cantonment areas, two airfields, and training areas.

The cantonment areas are the developed portions of the installation. They serve as the center for most activities on JBLM apart from field training. Land uses in the cantonment areas include family and troop housing, administrative uses, commercial uses (e.g., shops and medical services), industrial uses (maintenance, logistics, and transportation), and open space maintained as green belts and recreational use areas. Gray Army Airfield, located in the cantonment area supports rotary- and fixed-wing aircraft operations. The airfield consists of a 6,125-foot runway, aircraft hangers, airfield operations facilities, and a simulator facility.

McChord Airfield is located at the northeast region of JBLM. It has one active 10,108-foot (3,081-m) runway that supports, among other aircraft, a C-17 transport fleet operated by the Air Force. McChord Airfield can accommodate a variety of aircraft from the largest military cargo and commercial transport aircraft to small fighters. Battalions and companies rely on McChord Airfield to deploy around the world. The airfield also houses aircraft hangars, warehouses, airfield operations facilities, and a passenger terminal.

Training Areas represent the majority of JBLM (Figure 3-1). Training Areas include many different military training uses including maneuvering ranges, firing points, and drop zones. Dense forest covering much of the installation is ideal for light infantry maneuvers, which are primarily conducted on foot. Open areas provide adequate space for vehicle maneuvers and live-fire training at set ranges. Training areas also accommodate a variety of nonmilitary activities, such as recreation (e.g., hunting, fishing, horseback riding, and other outdoor recreation), commercial timber harvest. Training Areas also provide resources for Tribal members that support traditional and cultural ways of life.

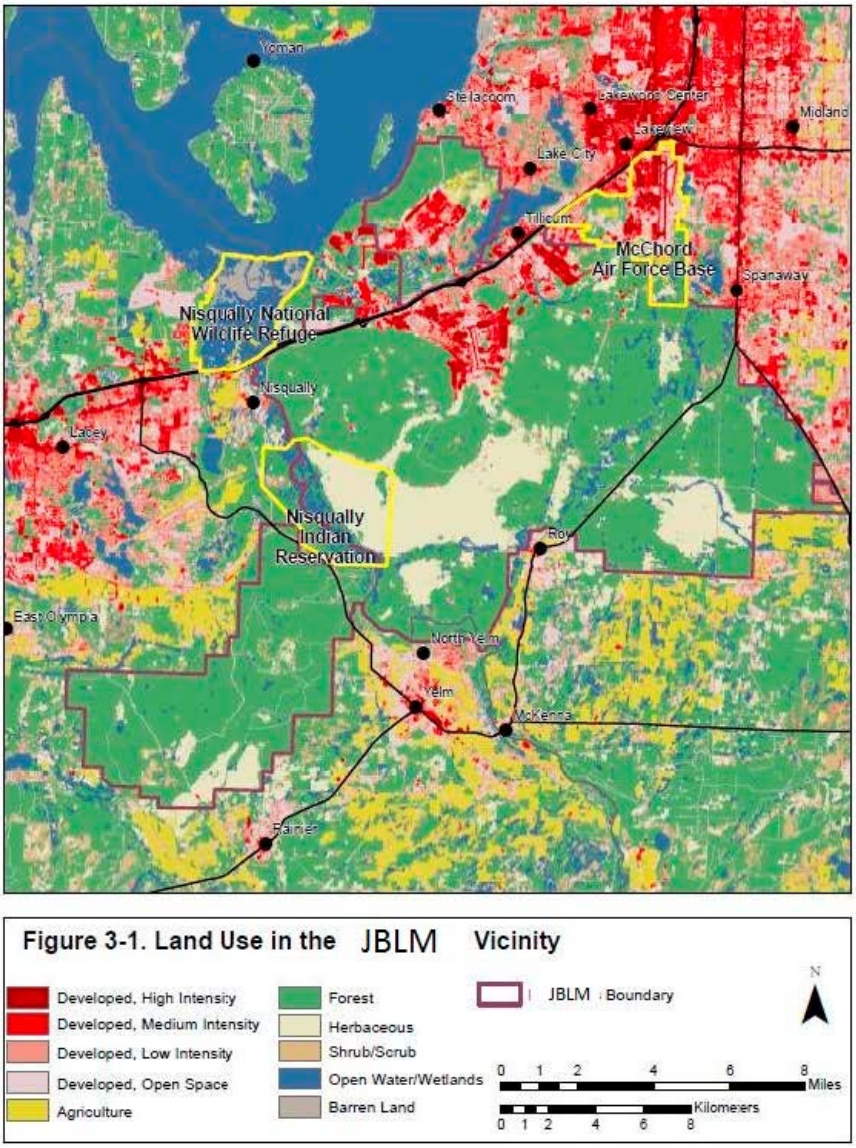


Figure 3-1. Land Use in the JBLM Vicinity

All live-fire military training occurs at established firing ranges. Live-fire training consists of individual weapons and crew-served weapons practice and qualification, and convoy live-fire training. Individual and crew-served weapons training occurs on fixed ranges with firing points and targets contained within marked areas and boundaries. At JBLM, effects of ammunition are concentrated at four impact areas: 1) Artillery Impact Area (AIA); 2) South Impact Area (SIA); 3) Central Impact Area (CIA); and North Impact Area (NIA). The vast majority of artillery training at JBLM occurs to the north and east of the AIA, in Training Areas (TA) 3, 4, 5, 6, and 12, with rounds fired into the AIA.

3.1.1 No Action Alternative

Under the no action alternative there would be no changes to current land use at JBLM, Hayes Hill would continue to be utilized as a firing point, and TAs 3 and 4 would continue to be utilized for military training activities.

3.1.2 Proposed Action – RRPR Noise Assessment Test Launch

The RRPRs would be fired from TA 3 on Hayes Hill and land in the AIA (Figure 2-3). The proposed action includes the harvesting of 1 acre of trees from the Hayes Hill firing point to provide trajectory clearance for RRPR firing. The cleared area would be a 1,174-by-134.5-foot rectangle located primarily in TA 4, adjacent to the proposed TA 3 RRPR firing point (Figure 2-4). This land is currently designated as training land. Under the proposed action, TA 4 would still be designated as a training area and the activities would be compatible with the surrounding land uses, as adjacent lands are also designated as training areas. No further training area adjustments would be required on JBLM. No other land use changes would be required for the implementation of the proposed action.

3.2 Noise

Noise can be defined as unwanted sound. Potential adverse effects associated with noise include diminished quiet at home; interrupted sleep; interrupted conversation and entertainment; interruptions at work and school; property damage such as broken windows; and disturbance to wildlife, livestock, or pets (U.S. Army Center for Health Promotion and Preventative Medicine [USACHPPM] 2001). Many factors influence an individual's response to noise, including the frequency of the noise and the time of day. The amount of background noise present also influences a person's level of annoyance to a noise disturbance.

The unit of sound measurement is the decibel (dB). The dB scale is a logarithmic measure used to quantify sound power or sound pressure. A number of factors affect sound as the human ear perceives it. These include the actual level of noise, the frequencies involved, the period of exposure to the noise, and changes or fluctuations in noise levels during exposure. In order to correlate the frequency characteristics from typical noise sources to the perception of the human ear, several frequency networks (systems of measuring units) have been developed (Table 3-1). At JBLM for large caliber weapons, noise levels are expressed in terms of linear peak levels, PK 15(met), which account for the statistical variations of meteorological conditions, and reflect the single event peak noise level exceeded by 15 percent of noise-generating events. The linear peak (dBP) typically is able to capture the low frequency energy responses responsible for noise

complaints and damage claims associated with large weapons explosions from artillery and demolitions (Army 2014).

Table 3-1. Commonly Used Decibel Scale

Decibel Scale	Description
dBA (A-weighted)	The human ear cannot perceive all pitches or frequencies equally well. Reflecting this fact, measures can be adjusted, or weighted, to compensate for the human lack of sensitivity to low-pitched and high-pitched sounds. This adjusted measurement unit is known as the A-weighted decibel, or dBA. The dBA is used to evaluate noise from transportation activities (traffic and aircraft).
dBC (C-weighted)	The C-weighted scale measures more of the low-frequency components of noise than does the A-weighted scale. This unit, symbolized as dBC, is used for evaluating impulse noise and vibrations generated by heavy weapons such as artillery, mortars, armor (20 mm or greater) and explosive charges.
dBP (Peak sound level)	The peak sound level (dBP) in a flat-weighted scale can be used to measure noise from small-arms (less than or equal to 20 mm) firing, heavy artillery, and explosives.

The Washington State Department of Ecology is the regulatory authority for environmental noise in Washington State. Maximum permissible sound levels, which are outlined in Washington Administrative Code (WAC) Chapter 173-60, are presented in Table 3-2. Most of the regional county and city noise regulations incorporate these guidelines, as well.

Under the WAC guidelines identified in Table 3-2, maximum permissible noise levels are reduced by 10 dBA for residential receiving properties between 10:00 P.M. and 7:00 A.M. The maximum noise limits may only be exceeded for the following durations: by 5 dBA for no more than 15 minutes in any hour; by 10 dBA for no more than 5 minutes of any hour; or by 15 dBA for no more than 1.5 minutes of any hour. Noise generating activities at JBLM that are exempt from the WAC rules include the following (between 7:00 A.M. and 10:00 P.M. only): discharge of firearms on authorized shooting ranges, blasting actions, construction at temporary construction sites, and aircraft in flight.

Table 3-2. Washington Department of Ecology Maximum Permissible Sound Levels (dBA)

Noise Source	**Receiving Property**			
	Residential		**Commercial**	**Industrial**
	Day	Night		
Residential	55	45	57	60
Commercial	57	47	60	65
Industrial	60	50	65	70
Source: WAC 173-60.				

BASELINE NOISE CONDITIONS

General day-night ambient noise level estimates for various types of land use within the United States vary widely, from approximately 35 dBA in wilderness areas to a maximum of 85 to 90 dBA in the noisiest urban areas. Additional examples of day-night noise levels for various land uses include approximately 40 dBA for rural residential areas, 45 dBA for agricultural cropland, 50 dBA for a typical wooded residential area, 60 dBA for an old urban residential area, and 69 dBA for urban row housing on a major avenue (USEPA 1978). Typical noise levels of common activities are presented in Table 3-3.

Table 3-3. Typical Noise Levels of Common Outdoor and Indoor Activities

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
Jet fly-over at 1,000 feet	110	Rock band
Gas lawn mower at 3 feet	100	
Diesel truck at 50 feet, 50 miles per hour	90	Food blender at 3 feet
Noisy urban area, daytime	80	Garbage disposal at 3 feet
Gas lawn mower at 100 feet Commercial area	70	Vacuum cleaner at 10 feet Normal speech at 3 feet
Heavy traffic at 300 feet	60	Large business office
Quiet urban area, daytime	50	Dishwasher in the next room
Quiet urban area, nighttime Quiet suburban area, nighttime	40	Theater (background) large conference room (background)
	30	Library
Quiet rural area, nighttime	20	Bedroom at night Concert hall (background) Broadcast/recording studio (background)
	10	
Lowest threshold of human hearing	0	Lowest threshold of human hearing
Source: Department of the Army 2003.		

Noise levels at JBLM are typically higher than average due to the military mission of the installation. Principal sources of loud noises on JBLM include aircraft (from Gray Army Airfield and adjacent McChord Airfield), vehicular traffic, trains, weapons firing, and munitions demolition. The highest noise levels originating on JBLM are associated with weapons noise and flyovers of jets and helicopters. Noise from large arms can be heard in the surrounding communities, as shown in Figure 3-2 below.

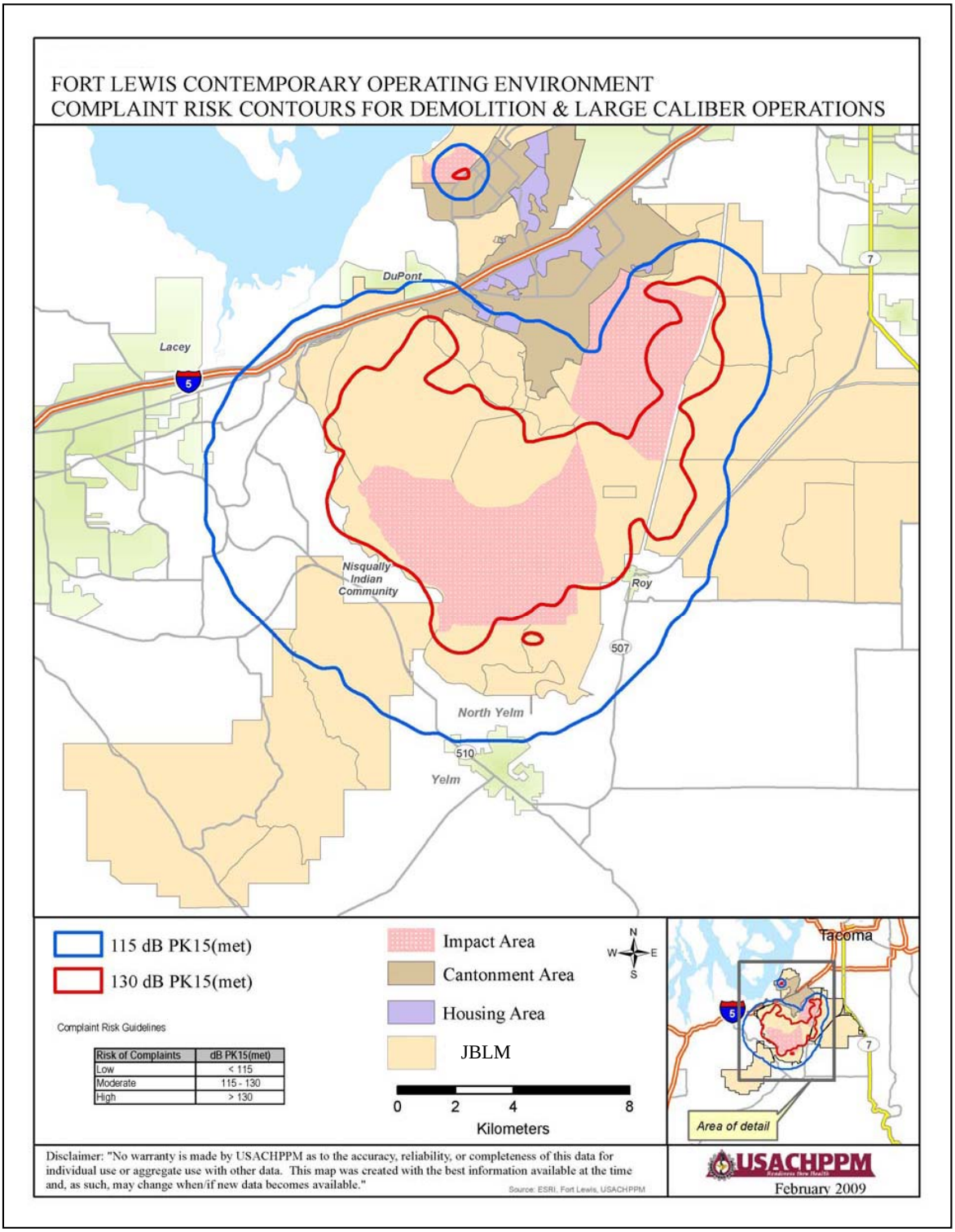


Figure 3-2. JBLM Large Caliber Weapons PK15(met) Noise Contours

3.2.1 No Action Alternative

There would be no changes to noise under the no action alternative. Training at JBLM, including large caliber weapon training, would continue and there would be no change in existing noise contours.

3.2.2 Proposed Action – RRPR Noise Assessment Test Launch

Launching of the RRPRs for the noise assessment would occur at the Hayes Hill firing point, and rockets would travel in a southeast linear path, landing in the AIA. Up to 27 rockets (nine rockets per day) could be fired over a 3-day period. Rockets would be launched from a few minutes to 1-hr apart. The Hayes Hill firing point is normally used for firing of the 155-millimeter (mm) howitzer firing.

BNOISE2 Modeling

BNOISE2 is software developed by the U.S. Army Construction Engineering Research Laboratory (CERL) that calculates and displays blast noise exposure contours resulting from large caliber weapons and explosive charges. The software allows the user to plot the predicted noise levels from a specific type of weapon, and takes into account the effects of topography, climate, and weather conditions to produce the worst-case scenario for noise impacts. The model calculates predicted noise level contours for the weapon system of interest and places them on a map. The model can produce noise level predictions in various noise decibel metrics. The model factors in sonic booms into its results.

The BNOISE2 model run by USAPHC for operational use of the RRPR rocket launched from the HIMARS at JBLM was run using PK 15(met), which describes the single event peak maximum noise level exceeded by 15 percent of events (e.g., 240 rifle or cannon “shots”). PK 15(met) measures the un-weighted peak sound level, or dBP, (as opposed to dBA), and is the instantaneous maximum sound level of an event as would be measured with a sound level meter. A dBP number for a given noise event will generally be higher than an A-weighted decibel value. Under 2003 North Atlantic Treaty Organization (NATO) noise guidelines, critical impulse noise levels for rifle fire are listed at 116 dBA, SEL (sound exposure limit for a duration of 1 second), which is roughly equivalent to a peak un-weighted sound of 153 dBP (NATO 2003).

USAPHC has used BNOISE2 and similar models to depict the noise contours for peak noise (PK 15[met]) from existing large caliber weapons firing at JBLM (Army 2014). These contours are shown in Figure 3-3, as a comparative tool for assessing noise impacts from RRPR test launch. As shown in the figure, peak noise levels of 130 dBP and above are restricted to areas within the installation boundary. 115-dBP noise levels extend into the surrounding communities, including City of DuPont, Nisqually Indian Reservation, City of Roy, and City of Yelm.

USAPHC-modeled potential peak noise levels for rocket launching from the Hayes Hill firing point at the 115 dBP, 115-130 dBP, and 130 dBP contours are shown in Figure 3-3. By comparing this figure with Figure 3-2, the predicted 115-dBP contour for RRPR rockets would

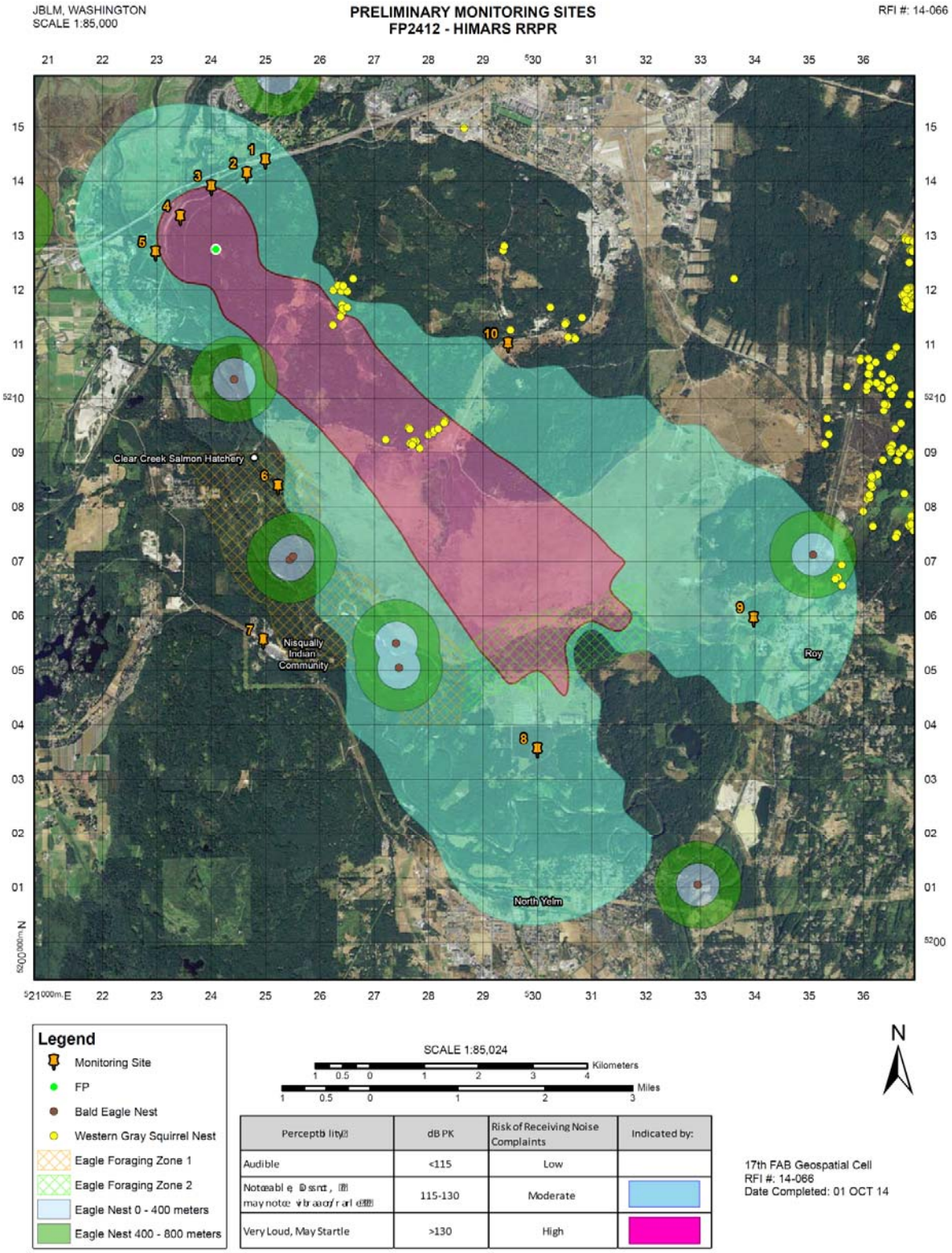


Figure 3-3. Predicted RRPR Noise Contours

not extend beyond the existing contour for large caliber weapons within the Roy and Yelm communities.

Though weather, climate and topographic conditions would affect actual site peak noise levels for firing events, similar findings for proposed RRPR rocket peak noise versus existing 155-mm howitzer peak noise are expected at JBLM. For most of the communities surrounding JBLM, the RRPR test launch would not represent an increase in frequency or intensity, of peak noise levels.

Characteristics of Sonic Booms

Although sonic booms are not expected during every RRPR firing, the potential for sonic booms remains under certain atmospheric conditions. As an object moves through the air at very high speeds it creates a virtual displacement of air, similar to a boat moving through water. The air molecules are pushed aside, forming a shock wave similar to the bow waves of a boat moving through the water. The larger the object or aircraft, the larger the air displacement, and the larger the shock wave. As the object exceeds the speed of sound (Mach 1) this shock wave is heard as a loud boom, commonly referred to as a sonic boom. With certain levels of propellant, rockets and projectiles (artillery shells) can exceed Mach 1 and create a sonic boom.

An airplane flying supersonically typically generates two main shock waves, one at the nose and one off the tail. Shock waves coming off other parts of the airplane tend to merge with the main shocks some distance from the airplane. The resulting pressure pulse changes to form an N-shaped wave, as shown in Figure 3-4. To an observer on the ground, this pulse is felt as an abrupt compression above atmospheric pressure, followed by a rapid decompression below atmospheric pressure and a final recompression to atmospheric pressure. The total change takes place in one-tenth of a second or less and is felt and heard as a double jolt or boom. Depending on the strength of the shock wave and other factors, the sonic boom may appear as one abrupt noise or two distinct booms.

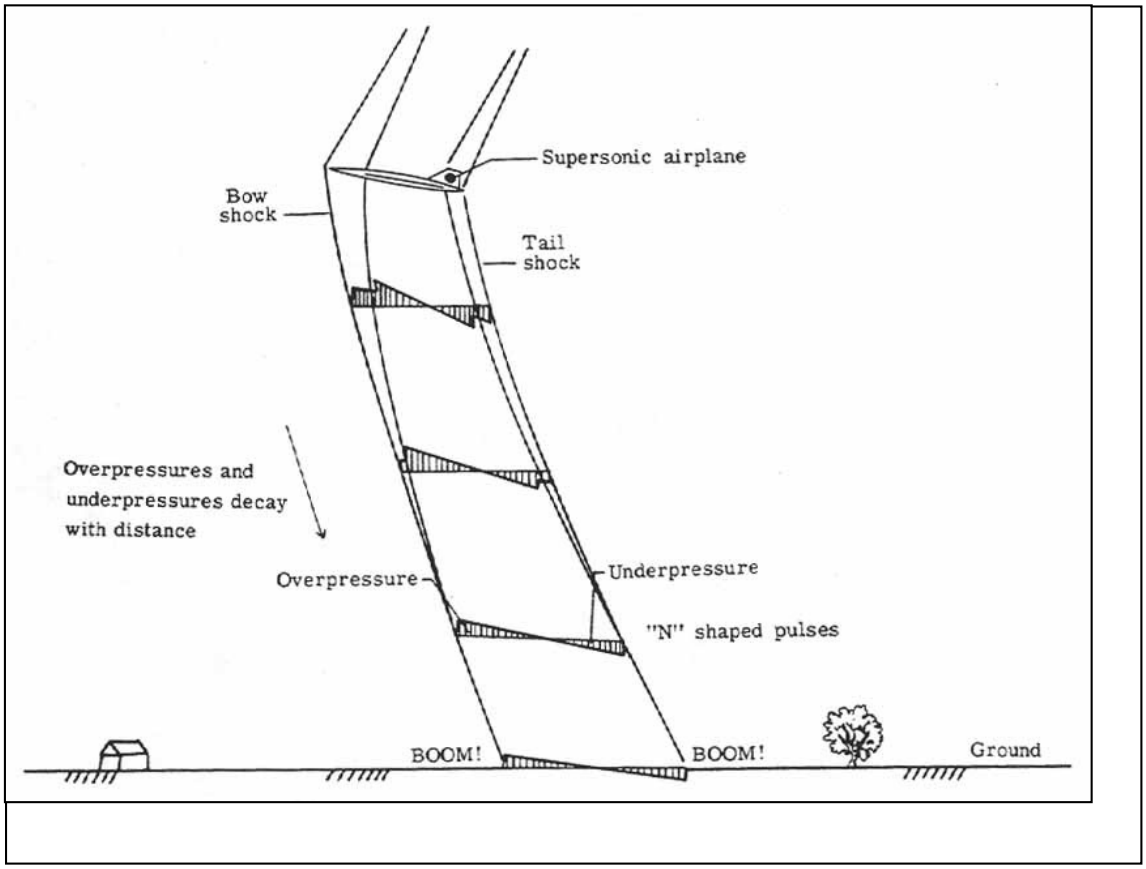


Figure 3-4. Diagram of a Sonic Boom

Many factors affect the intensity of a sonic boom (National Aeronautics and Space Administration [NASA] 2008):

- The weight, size and shape of the aircraft or object – As the size and weight of the aircraft or projectile increases, the intensity of the sonic boom increases. Altitude of flight – As the altitude of the aircraft or projectile increases, the intensity of the sonic boom at ground level decreases.
- The location of the receptor in relation to the object – The lateral (side to side) spreading of the sonic boom is primarily dependent on altitude, speed and the atmospheric conditions. The intensity of the shockwaves once reaching the ground, and the "loudness of the boom," are strongest directly below the object as shown in Figure 3-5.
- Atmospheric and weather conditions at the time of flight.
- The orientation of the aircraft's or object's axes relative to its direction of motion – The motion of an aircraft or projectile can cause distortions in shock wave patterns. This variable does not necessarily apply to inert projectiles such as conventional rockets and artillery shells, as they generally (laterally) travel in a straight line. Hills, valleys and other topographic features can create multiple reflections of shock waves, thus affecting the intensity of the boom.

RRPRs are of greater diameter than standard 155-mm Howitzer shells normally fired at the Hayes Hill firing point and other firing points on the installation. 155-mm howitzer shells can create a sonic boom under certain weather conditions.

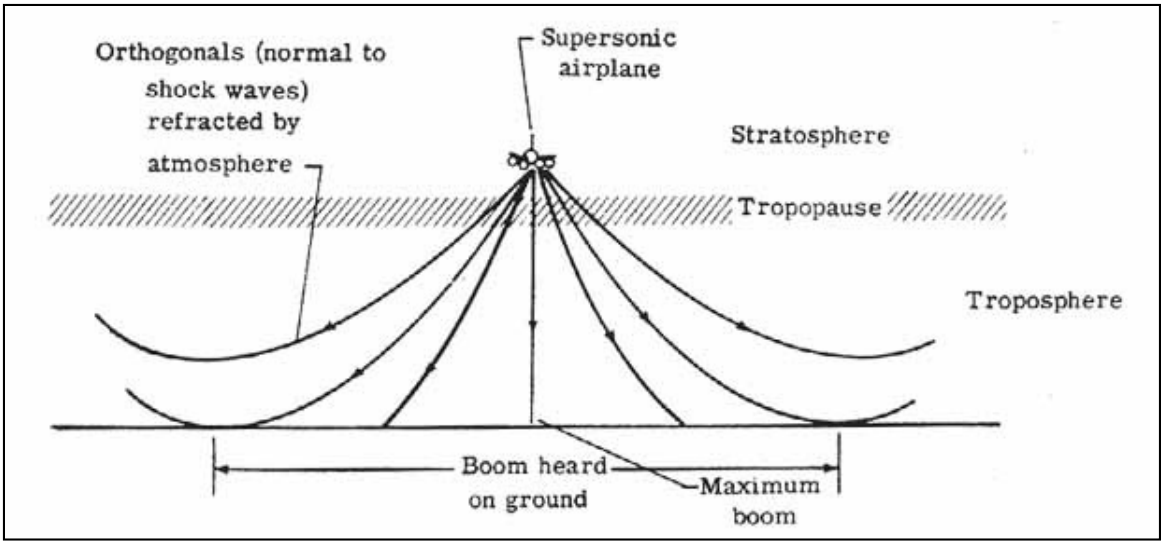


Figure 3-5. Refection of Shock Waves

Impacts to the General Public

As illustrated in Figure 3-3, the general public would potentially be affected by noise from the RRPR test launch. The level of the sound exposure would be dependent on weather and climate conditions, as well as an individual's location within a structure or outside. BNOISE2 modeling predicts that surrounding communities could be subjected to single event peak noise levels between 115 and 130 dBP. Exposure to these noise levels is likely to be disruptive and cause annoyance, but will not cause physical harm. The risk of physiological damage begins at noise levels of 140 dBP, which is not predicted to occur off of the installation.

As shown in Army Regulation 200-1, single event noise limits in Table 3-4 correspond to areas of low to high risk of noise complaints from large caliber weapons and weapons systems and weapon firing action taken by the Army. This table presents the risk of noise complaints based on level of noise. It also shows that at 140 dBP and greater is the permanent physiological damage to unprotected human ears threshold and there would be high risk of physiological and structural damage claims.

Table 3-4. Risk of Noise Complaints by Level of Noise

Large Caliber Weapons Noise Limits (dB) PK 15(met)	Risk of Noise Complaints
<115	Low
115-130	Moderate
130-140	High
>140	Risk of physiological damage to unprotected human ears and structural damage claims

For many of the communities surrounding JBLM, noise from rocket firing would be equivalent to that of large arms firing, although because of the difference in geographic coverage of the predicted noise effects, some people who are not currently annoyed by large caliber weapons firing might be annoyed by the RRPR firing. This impact would be temporary, over a three day period. The surrounding communities of Yelm, Roy, Nisqually Indian Reservation and DuPont are all located within the 115 to 130 dBP range, where noise impacts would be considered moderate. This area includes residential development within City of DuPont, Yelm, and Roy, as well as two schools in Roy. The risk of community annoyance in these areas is moderate, particularly at noise-sensitive receptors such as residences and schools. By comparing Figure 3-3 with Figure 3-2, the noise levels would be similar to the existing noise levels at I-5. Based on the predicted noise contours and associated mitigation measures (see below), impacts to the public associated with the RRPR test launch are anticipated to be less than significant.

Impacts to Structures

The impulsive sound pressure from the firing of large caliber weapons and the detonation of explosive charges can cause nearby structures to vibrate. The vibration is perceived by building occupants as the rattling of loose windows or unsecured objects within the structure. Private homeowners often express concern that these vibrations will cause damage to their homes. Vibrations, measured in inches per second, can be attributed to both ground-borne and airborne activities. During RRPR noise testing activities, vibrations attributable to the periodic creation of ballistic shock wave sonic booms could potentially occur. In the JBLM Installation Operational Noise Management Plan (IONMP), the Army states that typically homeowners become concerned about structural rattling and possible damage from vibration levels at 0.1 inches per second, and glass and plaster cracks at 0.5 inches per second (Army 2014).

Structures exposed to high-energy impulsive noise can crack for reasons unrelated to vibration and the noise environment, such as range of inside and outside temperatures and humidity; intensity and direction of wind; uneven building foundations; type of skin, frame, exterior materials, and interior finish; history of patching; and presence of water leakage (U.S. Air Force 1990). Vibration damage guidelines have been developed by the Army on the basis of past studies that predict threshold levels and probability of damage to structures. Siskind (1989) found that vibration levels of 0.1inches per second (corresponding to peak sound levels of 120 dBP) elicited homeowner concern over “rattling.” Based on the same study, under a worst case scenario of loose windows or stressed plaster walls, cracks to plaster and/or glass can occur with vibrations of 0.5 inches per second (corresponding to peak sound levels of 134 dBP), and structural damage to lightweight construction can occur at vibration levels greater than 2.0 inches per second (corresponding to a peak sound level of 175 dBP).

Based on BNOISE2 modeling by USACHPPM for the proposed alternative, no structures outside of the JBLM boundary would be within the area where damage to structures could occur. Noise levels outside of the JBLM boundary would not exceed 130 dBP (Figure 3-3). Because structural damage to buildings would not occur under predicted noise levels associated with RRPR firing, and because the chance of any damage to buildings (cracks in windows and/or plaster) would be extremely low. Less than significant impacts to buildings are expected under the proposed action.

3.2.3 Mitigation and Monitoring

Based on Army guidance, noise-related impacts from the RRPR test launch may cause annoyance from a community, but is not expected to result in significant impacts. Mitigation to reduce the amount of community noise exposure and potential for annoyance will be implemented, including the following measures:

- Do not fire rockets during late night time hours, or on holidays. The time window for the first firing event will be 9:00 A.M. to 6:00 P.M., with the window for subsequent events adjusted as monitoring data warrants (but not earlier than 7:00 A.M. or later than 10:00 P.M.).
- Ensure noise sensitive areas are notified prior to RRPR firing and provided a phone number where they can call to communicate noise complaints and/or to document the noise impacts (if any), of RRPR firing.
- Notify Nisqually tribal officials, city and county law enforcement agencies, 911 call centers, and local school officials, and the news media prior to the first firing event.

Additionally, cessation of operation will be considered if noise levels from the test launch exceed an average of 130 dBP for a day (average noise levels of nine rockets) at any monitoring station beyond the JBLM boundary. Any factors that could potentially stop the test will be taken into consideration and the decision will be made by the Installation Commander and 17th Field Artillery Brigade Commander. The response from the community regarding the RRPR noise assessment will assist the Army in determining the environmental consequences of potential long-term firing of RRPR at JBLM.

3.3 Air Quality

The Clean Air Act, as amended in 1990, requires the U.S. Environmental Protection Agency (USEPA) to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. Primary standards set limits to protect public health, and secondary standards set limits to protect public welfare (including protection against decreased visibility and damage to animals, crops, vegetation, and buildings). The NAAQS have been set for six principal pollutants, known as criteria pollutants: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), particulate matter less than 10 microns or 2.5 microns in diameter (PM_{10} and $PM_{2.5}$), ozone (a product of VOCs and nitrogen oxides (NOx) reacting in the atmosphere), and sulfur dioxide (SO_2). They are based on concentrations averaged over various time periods. Standards for pollutants with acute health effects are based on relatively short-term periods (1-hour, 3-hour, 8-hour, or 24-hour), while additional standards are based on relatively long time periods (quarterly and annually) to gauge chronic effects. Individual states are responsible for regulating pollution sources.

Under the General Conformity Rule of the Clean Air Act, Section 176(c), USEPA established certain statuary requirements for federal agencies with proposed federal activities to demonstrate conformity of the proposed activities with the State Implementation Plan for attainment of the NAAQS. Certain actions are exempted from conformity determinations, while others are presumed to conform if the total project emissions are below *de minimis* levels and less than ten percent of the regional emissions inventory. The USEPA has divided the country into geographical

regions known as Air Quality Control Regions (AQCRs) to evaluate compliance with NAAQS. JBLM is located in the Puget Sound Intrastate AQCR and the Olympic-Northwest Washington Intrastate AQCR. The USEPA designates AQCRs as either attainment or nonattainment areas for each of the individual criteria pollutants. Attainment areas have concentrations of criteria pollutants below NAAQS, and non-attainment areas have concentrations above NAAQS. Maintenance areas are attainment areas that had a history of non-attainment but are now consistently meeting the NAAQS. Toxic air pollutants (also known as toxic air contaminants) are known or suspected to cause cancer or other serious health effects, or adverse environmental effects (USEPA 2008). Emissions of toxic air pollutants must be below Acceptable Source Impact Level (ASILs), which are concentrations established by regulatory authorities to evaluate air quality impacts. Toxic air pollutants are referred to as hazardous air pollutants under the Clean Air Act. National emission standards for hazardous air pollutants (NESHAPs) are technology-based limits on the release of hazardous air pollutants from industrial sources. They are not based on health risk considerations.

3.3.1 No Action Alternative

Under the no action alternative, there would be no change to existing air emissions associated with training of the 17th Field Artillery Brigade at JBLM. Under this alternative, impacts to air quality will continue to be affected by non-rocket launching training activities, including vehicle and generator emissions. JBLM is currently in compliance with their synthetic minor operating permit and is operating well below the thresholds for air emission contaminants. Impacts to air quality associated with the no action alternative are considered to be less than significant.

3.3.2 Proposed Action – RRPR Noise Assessment Test Launch

For federal projects, significance of impacts associated with the Proposed Action is based on compliance with both the NAAQS and the General Conformity Rule. Impacts to air quality would be considered significant if the proposed activities were to: 1) increase ambient air pollutant concentrations above any NAAQS; 2) contribute to an existing violation of any NAAQS; 3) interfere with or delay timely attainment of NAAQS; 4) impair visibility within any federally mandated PSD Class I area; or 5) produce emissions of hazardous air pollutants exceeding state or federal emission levels at the installation boundary.

The Code of Federal Regulations requires a determination of whether a federal action will cause an increase in total direct and indirect emissions above specific thresholds, thereby requiring a conformity analysis (40 CFR Part 51 Subpart W and Part 93 Subpart B). A conformity analysis must demonstrate that the project would not:

- Cause or contribute to a new violation of any standard;
- Interfere with the provisions in the applicable State Implementation Plan for maintenance of any standard;
- Increase the frequency or severity of any existing violation of any standard; or
- Delay any timely attainment of any standard.

Additional thresholds are pollutant-specific for non-attainment and maintenance areas. JBLM is located within an ozone and CO maintenance area. The existing JBLM air emissions inventory

has total emissions below the statutory limit of 100 tons per year of ozone or CO. Any action that produces additional ozone or CO emissions that cause the installation emissions inventory to exceed 100 tons per year would trigger a conformity analysis.

Harvest of trees for trajectory clearance would result in minor emissions associated with use of vehicles and harvesting equipment. Given the small area to be cleared and the relatively short duration of the timber harvest, these one-time emissions are expected to be minor and short term.

In the 2009 EA, air emissions were modeled for the long-term HIMARS training at JBLM and YTC using RRPRs which are presented in Appendix A of this EA. Emissions resulting from long-term firing of RRPRs would not exceed the JBLM base-wide conformity thresholds of 100 tons per year for NOx, VOC, or CO. The estimated annual emissions for long-term RRPR firing at JBLM were 5.22 tons per year of CO and <0.01 tons per year of NOx. The proposed RRPR test firing, total of 27 RRPRs for the noise assessment would be substantially fewer rockets than the 2009 proposed long-term RRPR firing at JBLM, up to 216 RRPRs per year. Therefore the proposed noise assessment is expected to have even lower air emissions than the previous proposed long-term HIMARS training at JBLM.

A health hazard assessment report for HIMARS (USACHPPM 2005) reviewed the chemical substances present in exhaust and combustion products from the rockets. Out of these pollutants, and the respective emissions generated during rocket launches, only hydrogen chloride (HCl) was identified as being of concern from a human health perspective. Outside the launcher cab, concentrations of this substance can exceed the exposure limit (100 ppm) up to a distance of 140 feet from the launcher. The report also stated that HCl is highly reactive, and that high levels quickly dissipate within seconds after the launch. The Hayes Hill firing point is approximately 3,600 feet from the installation boundary, more than 25 times this distance.

JBLM is currently in compliance with their synthetic minor operating permit and is operating well below the thresholds for air emission contaminants. The Acceptable Source Impact Level (ASIL) for HCl is 7.0 μg/cubic meter (0.007 mg/cubic meter; 24-hour average; WAC 173-460). Given that the noise assessment will result in a temporary impact, rockets are a sporadic source of emissions (up to 9 rockets a day), and that HCl quickly dissipates in the air, it is not expected that HCl emissions from RRPRs would exceed the ASIL at the installation boundary. Emissions from the proposed RRPR firing would be negligible. They are substantially less than 10 percent of the total annual emissions for the Puget Sound region, and do not represent a regionally significant generation of emissions. Therefore, a general conformity determination is not required. Therefore, effects to air quality are expected to result in less than significant impacts.

3.4 Fire

Approximately 80 percent of the fires on JBLM are the inadvertent result of military training exercises, particularly those that involve tracers, smoke grenades, flares, campfires, and other ignition sources. The remainder of the fires that occur on the installation are caused by other activities, and usually occur in the cantonment area. In forests, a typical fire year is characterized by numerous small fires that are quickly extinguished, and an annual burned acreage of less than 500 acres.

Forests on JBLM are managed for a low risk of catastrophic fire, in order to develop a relatively stable and sustainable set of environments within the installation. In training areas, many of the smaller fires are extinguished by troops. Larger wildfires are suppressed, unless they fall within the parameters of planned prescribed burns; these fires are allowed to burn under Army observation, usually to the limits of the next firebreak. Firebreaks on JBLM, which limit the spread of fires, consist of streams and paved or gravel roads. Forestry equipment operators grade many range roads and firebreaks annually in support of fire control efforts. Fire fighters ignite backfires to control the spread of wildfires in impact areas, rather than enter areas with potential unexploded ordnance (UXO) hazards.

Careful prescribed burning is used to maintain a landscape pattern of variable, discontinuous fuels similar to what would develop under a natural fire disturbance regime. In addition, JBLM Forestry Program staff conduct prescribed burns in oak woodlands and ponderosa pine savannas to control invasive species and encourage open understory conditions. Burns conducted on prairies often include adjacent forested areas, as well, helping to halt the spread of forests onto the prairies and maintain the open understory conditions of the forest ecotone.

A wildland fire manager establishes fire danger levels for JBLM, which depend on the weather and fuel moisture conditions. During periods of high fire danger, use of pyrotechnics and other ignition sources during training is limited. To reduce the risk of wildfires occurring and spreading in training areas, early detection, firebreaks, and prescribed burning are utilized. Early detection is usually made by military troops or people with area access permits, and fires are reported to the fire dispatcher.

Although wildfire suppression is the fire management approach utilized over most of the installation, many accidental ignitions in prairie habitats are allowed to burn. In the Artillery Impact Area (AIA) in particular, ignitions caused by exploding shells occur regularly during the dry summer months. These fires, which typically are not extinguished, burn an estimated 2,470 to 3,000 acres of predominantly prairie habitat each year (Tveten 1997). Regular fires have helped maintain high quality prairie habitat throughout much of the AIA.

3.4.1 No Action Alternative

Under the No Action alternative, the 17th Field Artillery Brigade would continue to engage in training activities that include minimal use of pyrotechnics and tracer rounds, which have a risk of starting fires on training lands. Tracer rounds used during weapons training (primarily nighttime machine gun firing) would be fired into an impact area. Impact areas on JBLM, and particularly the AIA, are subjected to repeated low-fuel grass fires and therefore have a low buildup of heavy fuels. Most fires in the impact areas are low-intensity burns in fire-adapted systems that would not be expected to have significant or lasting effects on the human environment. No change to fire impacts are expected with the no action alternative.

3.4.2 Proposed Action – RRPR Noise Assessment Test Launch

Timber harvest near the Hayes Hill firing point would have a negligible impact on fire risk. Appropriate safety precautions to prevent fire during harvesting would be required. Clearing the

trees from the area would help minimize the risk of fire associated with rocket launching, as described in the following paragraph.

Since the test rockets are non-explosive and the propellant is expended 2 to 3 seconds after ignition, the empty tube reaching the AIA would be inert and would not present a fire risk. However, there would be some fire risk associated with the backblast of rockets at the launch site. Ignition of the rocket, as well as hot debris (mostly covers and fragments of covers), would have a risk of starting a fire if it was to come in contact with dry plant materials, and there would be a risk of fire spread if sufficient fuels were present in the vicinity. The Hayes Hill firing point is an open, cleared area with sparse, low vegetation and few fuels to support a fire, although forested habitat is present nearby. During the RRPR test launch noise assessment, soldiers would check the launch site for fires following the release of each rocket launch, and would quickly extinguish any that were present. Additionally, firebreaks in the area (predominantly roads) would provide added protection against the spread of fire over a large area. Thus, the proposed action is not expected to cause significant fire damage to resources on the installation.

3.5 Soils and Geology

Soils. JBLM is dominated by glacial deposits such as till and outwash. Soil on the installation is relatively shallow and soil fertility is low to moderate. The most common soil types on JBLM are excessively-well drained, sandy-gravelly prairie soils over glacial outwash. These soil types, which are represented by the Spanaway and Nisqually soil series, are widely distributed throughout the installation. Other major soil types include moderately well-drained, sandy-gravelly forest soils over glacial till, which are common in the southern portion of the installation and generally support forest vegetation. Because soil on JBLM is typically permeable and coarse-textured, and because the topography is relatively level, very little natural erosion occurs. The potential for erosion on JBLM is confined to steep slopes.

Topography. The topography of JBLM is typically flat to gently rolling, with localized moderately sloping areas. The elevation throughout most of the installation ranges between 250 and 400 feet above sea level. However, topography varies from sea level at Puget Sound to 567 feet in the extreme southwest portion of the installation (Defense Mapping Agency 1990).

Geology. Continental glacial deposits originating approximately 13,500 years ago dominate the geology of JBLM. Overall, the geologic material is predominantly comprised of outwash gravels and till. The majority of the installation north of the Nisqually River is comprised of a series of glacial outwash terraces, channels, and glacial ponds. The low hills in the western portion of this area are comprised of glacial deposits of undifferentiated till, often mixed with outwash gravels.

3.5.1 No Action Alternative

Under the No Action Alternative, no changes to soil or geology would occur. Current levels of maneuver and live-fire training activities in TA 4 and the AIA would continue, and disturbed areas would continue to be managed in accordance with the JBLM Integrated Natural Resources Management Plan.

3.5.2 Proposed Action – RRPR Noise Assessment Test Launch

Clearing of the 1-acre area adjacent to the Hayes Hill firing point would entail use of heavy equipment off established roads, and would result in complete removal of tree cover from the area. Although these activities have the potential to affect soil through compaction and erosion, the risk of adverse effects to soil are minimal given the physical characteristics of the soil and the level topography of the site. The soil survey for Pierce County (Zulauf 1979) indicates that the sandy-gravelly prairie and forest soils in the vicinity of the area to be cleared have little or no erosion hazard, and are suitable for tree harvest by conventional methods year round. The one-time harvest at the site would not be expected to cause significant damage to soil function or productivity. Depending on the results of the noise assessment, trees would be replanted in the 1-acre cleared area or the area would be colonized by grasses and maintained in a non-forested condition for training purposes.

Minimal disturbance of soil would be associated with battalion activities, as vehicles would primarily travel on established roads and trails. Minor amounts of soils disturbance and compaction could occur. Firing of RRPRs during the noise assessment would produce exhaust emissions that include small quantities of aluminum compounds, hydrochloric acid, and other residues. The chemical constituents of these combustion products are all found naturally in the soil. The 3-day test launch at the Hayes Hill firing point is not expected to alter the chemistry of soil in this localized area.

3.6 Water Resources

Surface water resources at JBLM include rivers, streams, lakes, wetlands, and marine areas. Aquatic habitats are widely distributed over JBLM, covering roughly 4,500 acres of the installation. Four major source water drainage basins occur on JBLM: the Nisqually River basin, the Sequalitchew Creek basin (including American Lake), the Deschutes River basin, and the Chambers Creek basin. Approximately 56 percent of JBLM falls within the Nisqually River Basin. The Nisqually River crosses through the installation and empties into Puget Sound. Major streams on the installation include Murray Creek, Sequalitchew Creek and Clover Creek.

Surface water quality on JBLM is generally within Washington State standards, although some water bodies on the installation occasionally exceed these standards. The water temperature at American, Nisqually, and Sequalitchew lakes has been recorded above state standards, and phosphorous and fecal coliform levels in Muck Creek and the Nisqually River occasionally exceed state standards.

The regional groundwater system consists of an alternating sequence of aquifers (water bearing strata of sand and gravel) and aquitards (strata composed of silts and clays not capable of producing significant amounts of water (Public Forestry Foundation 1995). Shallow groundwater in the unconfined aquifers throughout JBLM range from 10 to 30 feet in depth with lesser depths near lakes, streams and greater depths beneath hilly areas. Lower aquifers at depths of 100 – 500 feet below ground surface are known and in use for the base drinking water supply. Local recharge of groundwater is provided by infiltration of precipitation, stormwater runoff, and reaches of lakes and streams that lie above the prevailing water table. Monitoring records for the JBLM water system indicate that, with few exceptions, water quality is in compliance with state and local

requirements for water supplies (Gray and Osborne, Inc. 1991, Anteon Corporation 2003). However, groundwater quality beneath certain areas (primarily within the cantonment areas) has been adversely affected by past activities (i.e., waste disposal, fuel leakage, and chemical spills).

The Central Pierce County Aquifer System was designated a sole-source aquifer by USEPA in 1993, because it supplies approximately 60 percent of the average drinking water demand and more than 80 percent of the peak drinking water demand for the area. Because of this designation, new solid waste landfill cells cannot be constructed on JBLM, and groundwater conditions may impact future land-use decisions on the installation.

3.6.1 No Action Alternative

Under the no action alternative, no changes to the quality and quantity of water resources on JBLM are expected.

3.6.2 Proposed Action – RRPR Noise Assessment Test Launch

The 1-acre area adjacent to the Hayes Hill firing point that would be cleared for trajectory clearance under this alternative is not located in the vicinity of any surface water resources or wetlands. The closest surface water to the area to be cleared is the Nisqually River (approximately 7,400 feet away at its closest point). As discussed in previous sections, the risk of soil erosion at this site is minimal, given the coarse nature of the soils and the level topography of the site. Since the nearest water is approximately 7,400 feet away, risks for adverse effects to water caused by erosion and sedimentation from the cleared area are low and not considered significant.

Exhaust from RRPRs contains small quantities of chemicals that can be hazardous in large concentrations, such as aluminum compounds and hydrochloric acid. These compounds could potentially alter water chemistry if they were to reach water sources, either by direct deposition into water from the air or by transport of contaminated soil into water bodies. Since the nearest water is approximately 7,400 feet away from the firing point, impacts to nearby surface water and wetlands would be negligible. Smoke from rockets would begin to dissipate immediately after launch, and would tend to rise into the air. It is not reasonably foreseeable that air contaminants would enter water in large enough quantities to impact water quality, after traveling more than 7,400 feet from the launch site. Additionally, given the flat topography in the area and the low erodibility of the soil, it is not likely that the small quantity of contaminants reaching the soil would eventually end up in surface water approximately 7,400 feet away.

The potential for contamination of water in the impact area is low, since the practice rockets do not have explosive warheads and do not explode on impact. The rocket propellant would be consumed shortly after ignition, leaving only scrap materials as debris in the impact area. Since JBLM conducts a semi-annual “spring cleaning” where debris is removed from the impact areas, it is not likely that these scrap metals would potentially result in some soil contamination due to degradation over time. JBLM also monitors groundwater quality near the impact area to ensure water quality standards are met and long-term water quality degradation does not occur. Risks associated with ordnance contaminants in groundwater would be negligible due to the limited nature of the RRPR firing, and due to JBLM’s past measurements of contaminants which have shown less than significant impacts.

3.7 Fish

Approximately 25 fish species, including resident, anadromous, and warm-water species, live in aquatic habitats on JBLM (ENSR 2007). Common resident and anadromous fish species that may occur on JBLM include steelhead/rainbow trout, Chinook salmon, chum salmon, coho salmon, pink salmon, sockeye salmon/kokanee, cutthroat trout, and mountain whitefish. Common warm-water species include rock bass, largemouth bass, brown bullhead, bluegill sunfish, pumpkinseed sunfish, black crappie, and yellow perch.

The north end of JBLM is adjacent to approximately 2.5 miles of shoreline. This area provides habitat for out-migrating juvenile anadromous salmonids and in-migrating adult salmonids using the Nisqually River to the south and Chambers Creek to the north.

Fish species present in south Puget Sound and near the installation include Pacific herring, surf smelt, hake and lingcod, pollock, rockfish, surfperch, flounder, sole, spiny dogfish, Chinook salmon, chum salmon, coho salmon, pink salmon, sockeye salmon, and sea-run cutthroat trout. Puget Sound is also home to many shellfish and crustaceans, among them: dungeness crab, red or rock crab, spot prawn, geoduck, Japanese oyster, Olympia oyster, European flat oyster, horse clam, butter clam, manila clam, native littleneck clam, soft-shell clam, spiny scallop, pink scallop, rock scallop, pinto abalone, sea urchin, and sea cucumber. Shellfish and crustaceans are abundant within Puget Sound in near-shore, shallow areas to depths greater than 300 feet, although they are not found in major abundance near JBLM (PSWQA and WDNR 1992).

The Nisqually Indian Tribe operates a fish hatchery on Clear Creek a tributary to the Nisqually River approximately (2.3 miles) from the Hayes Hill firing point. The Clear Creek Fish Hatchery was established in 1991 on land made available for the site under a lease agreement between the Army and the Nisqually Indian Tribe. The USFWS built and owns the hatchery, and the Tribe operates the hatchery under an agreement with the USFWS. The hatchery raises Chinook salmon (Tschaekofske et al. 2004).

3.7.1 No Action Alternative

Under the no action alternative, there would be no increased risk for direct or indirect impacts to fish and other aquatic organisms.

3.7.2 Proposed Action – RRPR Noise Assessment Test Launch

Noise associated with rocket firing and the accompanying sonic booms could temporarily affect fish behavior, particularly along Muck Creek, which could be exposed to noise levels in excess of 130 dBP, according to noise modeling (see Figure 3-3). Noise and vibrations from sonic booms could potentially reach the Clear Creek Fish Hatchery, located on Clear Creek approximately (2.3 miles) from the Hayes Hill firing point (shown on Figure 3-3). However, disturbance to the hatchery is expected to be minor, as the hatchery is located in the modeled notable (115-130 dBP) noise contour.

As shown in Figures 3-2 and 3-3, peak modeled noise levels for RRPR firing are similar to those for large caliber weapons (such as 155-mm Howitzers), which are currently fired regularly at Hayes Hill and other locations on JBLM. Peak noise levels from RRPRs greater than 130 dBP would be fully contained within JBLM boundaries. Currently, down-range portions of the Nisqually River, including the Clear Creek Fish Hatchery, are exposed to noise levels greater than 130 dBP from large caliber weapons, but would be exposed to lower noise levels (between 115 and 130 dBP) from RRPRs. Therefore, peak noise levels experienced by fish would not increase from existing levels as a result of the proposed RRPR test launch. One study of salmon hearing determined that salmon are unlikely to detect sounds originating in the air, and that their hearing is masked by the turbulence in their river habitat (Popper and Clarke 1976). Based on this information, it is not expected that noise associated with the RRPR test launch would have a significant effect on fish populations in Muck Creek, Nisqually River, Puget Sound, or other nearby aquatic habitats.

Sonic booms and associated noise could impact fish behavior and survival. Past observations at areas exposed to sonic booms from aircraft included mortality of trout eggs in a critical stage of development within 5 minutes after exposure (Rucker 1973), and startle and jumping responses in guppies and other fish (USFWS 1988). At a federal fish cultural laboratory, striped bass were observed to jump out of their tanks or die of seizures in the water after being exposed to intense, “focused” sonic booms (USFWS 1988). However, other studies conducted on the effects of sonic booms on trout and salmon eggs and fry have generally indicated no increase in mortality or effect on fish eggs (USFWS 1988). One controlled experiment comparing mortality of eggs and fry of several species of salmon and trout after exposure to sonic booms from military planes with mortality in a control group found comparable mortality rates (Rucker 1973). It is expected that the shock wave from an airplane would be much greater than that from an RRPR because its diameter is much greater. In the same study, Chinook salmon eggs in a simulator were exposed to sonic booms of varying overpressures at regular intervals during their development, with no noticeable increase in mortality or influence on normal development. Salmon were raised to the feeding (swim-up) stage and compared to a group of fish raised in a normal, undisturbed manner. These controlled tests indicate that sonic booms from RRPRs would not have a detrimental effect on fish spawning in the Clear Creek Fish Hatchery or in habitat in and around JBLM.

The targeted area within the AIA is near Nisqually Lake and Muck Creek, with distances dependent on the precise spot the rocket shell lands. It is unlikely that rockets fired during the test launch would land in either of these water bodies. Additionally, the rocket propellant would be completely expended 2 to 3 seconds after ignition, and therefore would not be present in the rocket shell upon landing, although it is possible that some residue would be present. Chemical residues from RRPR smoke cartridges (34 percent potassium perchlorate and 66 percent aluminum) could potentially affect aquatic organisms. Potassium perchlorate may impact fish thyroid activity at concentrations greater than 10mg/L (Crane et al. 2005), but it is highly unlikely that these concentrations would occur in fish-bearing waters in the AIA since the proposed landing site for the rocket is away from fish-bearing waters.

As discussed in previous sections, exhaust from rockets contains small quantities of chemicals that can be hazardous in large quantities. Rocket motor exhaust components predominantly contain aluminum oxide, carbon monoxide, carbon dioxide, hydrogen chloride (HCl, hydrochloric acid),

water, and nitrogen (98.08%). Of these emissions, carbon monoxide and hydrochloric acid are of greatest concern to fish, and fish kills have been reported in lagoons near launch pads following launches of the Space Shuttle (Brown and Root Environmental 1996). At JBLM, HCl in rocket motor exhaust would be in a vapor state and would dissipate near the launch site (U.S. Army Aviation and Missile Command 1998). It is unlikely that sediments or rocket motor exhaust constituents would be transported to the Nisqually River. If HCl were to reach the Nisqually River, it would be rapidly diluted and flushed from the river and would have a negligible to no effect on the water pH (Brown and Root Environmental 1996). Therefore, effects to fish and other aquatic resources in the river or estuary at the mouth of the river would not be significant.

RRPR launching carries the risk of fire at the launch site. A fire could impact fish or other aquatic resources if vegetation in the 50 meter (164-foot) aquatic buffer zone was burned. Removal of this vegetation could potentially increase sedimentation into the aquatic habitat and temporarily raise water temperatures, both of which can be harmful to fish. Risk of fire would be minimized by the fire management procedures discussed in Section 3.4.2. During the RRPR test launch, soldiers would check the launch site for fires following the release of each rocket, and would quickly extinguish any that were present. It is expected that any fires started during the test launch would be contained before reaching riparian habitat.

3.8 Wildlife and Domestic Animals

JBLM has a mosaic of plant community distributions and productive wildlife habitats utilized by approximately 20 species of reptiles and amphibians, 200 species of birds, 50 butterfly species, and 50 species of mammals (ENSR 2007). Large expanses of undeveloped, low-elevation, wetland and upland habitats occur throughout the installation. These habitats are also present in the areas surrounding the installation, although they generally exist as small, fragmented pieces given the extensive development in the region.

Most terrestrial mammal species are permanent residents whose off-site habitats have undergone urbanization. Approximately half of the bird species typically found using the varied habitats of JBLM are permanent, year-round residents, with 35 percent as summer residents. Most of these bird species use JBLM as habitat for breeding. Waterfowl typically use the wetlands of JBLM as over-winter forage and migratory resting habitats (CH2M HILL 1994a).

Forests. Forests are the largest ecosystem type on JBLM and in the region, predominantly consisting of coniferous forests dominated by Douglas-fir. As the largest remaining contiguous block of natural landscape in the south Puget Sound area, JBLM is a critical component in regional attempts to preserve and enhance biological diversity. Forestlands adjacent to JBLM are mostly fragmented and less valuable to forest-dependent species than forests on the installation. Wildlife species typically associated with forested environments inhabit a wide array of habitat conditions. Important factors influencing the distribution and abundance of wildlife species within forests include the seral stage of forest stands and the quantity and distribution of coarse woody debris and snags. Common forest-dwelling amphibians and reptiles include Northwestern salamander, long-toed salamander, Western toad, common garter snake, and rubber boa. Larger trees and snags are utilized as foraging, nesting, and perching sites for bald eagles, great blue herons, osprey, band-tail pigeons, and a variety of woodpeckers and owls (Kavanagh 1991). The coniferous forests are

also home to chickadees, nuthatches, and brown creepers, while ruffed grouse, kinglets, and warblers are attracted to deciduous and mixed coniferous-deciduous forests. The forest edge is utilized by upland game birds, bluebirds, thrushes, flycatchers, and warblers. Forests provide cover and forage for a variety of mammal species, including Columbia black-tailed deer, raccoon, coyote, black bear, various bat species, Townsend chipmunk, and northern flying squirrel. Several wildlife species of concern, including bald eagle, pileated woodpecker, and several neotropical birds, rely upon the installation's large blocks of forest for all or part of their life history needs.

Prairies/Grasslands. The grassland landscape in South Puget Sound once extended from just south of Tacoma to beyond Oakville along the Chehalis River (The Nature Conservancy 1998). In 1995, less than 3 percent of that area remained as grassland (Crawford and Hall 1997). However, a significant portion of JBLM still contains native grasslands. The grasslands represent some of the last remaining grasslands in western Washington.

Native grasslands provide habitat for several rare plant and animal species, such as white-top aster, pocket gopher, and several species of butterflies. Prairies are used for foraging and/or nesting for hawks, common nighthawks, lazuli buntings, swallows, and sparrows. Bird species occurring at JBLM specifically adapted to prairie environments include the western bluebird, streaked horned lark, western meadowlark, vesper sparrow, and savannah sparrow. Prairies provide food and limited cover for small- and medium-sized mammals such as pocket gopher, deer mouse, vagrant shrew, Pacific jumping mouse, moles, and eastern cottontail.

Oak Woodlands. Since Euro-American settlement, over half of all oak habitat in the south Puget Sound region has been eliminated. Historically, oak savanna and open woodlands were common and consisted of large, continuous stands containing large, mature, widely spaced oaks with single trunks and broad, spreading crowns. The understory was a single herbaceous layer of native bunchgrasses and forbs. Frequent and regular fires helped to maintain these communities.

Oak woodlands occur predominately on grassland margins and provide important transitional wildlife habitat between grassland and forest ecosystems. Oregon white oak woodlands are used by an abundance of mammals, birds, reptiles, and amphibians. Many invertebrates, including various moths, butterflies, gall wasps, and spiders, are found exclusively in association with this oak species. Oak/conifer associations provide contiguous aerial pathways for animals such as the state threatened western gray squirrel, and they provide important roosting, nesting, and feeding habitat for wild turkeys and other birds and mammals. Dead oaks and dead portions of live oaks harbor insect populations and provide nesting cavities. Acorns, oak leaves, fungi, and insects provide food. Some birds, such as the Nashville warbler, exhibit unusually high breeding densities in oak. Oaks on JBLM may play a critical role in the conservation of neotropical migrant birds that migrate through, or nest in, Oregon white oak woodlands (Washington Department of Fish and Wildlife 2008b). Oak woodlands provide important forage and nesting habitat for black-tailed deer, Douglas squirrel, and northern flying squirrel.

Wetlands. Approximately 4,500 acres of wetlands occur on JBLM. Wetlands are widely distributed throughout the installation, and range in type from open water to forested swamps. They support numerous species of plants and animals. Ten amphibian and four reptile species were detected on JBLM during a 1996-1997 herpetofauna inventory, including the Northwestern

salamander, long-toed salamander, Pacific giant salamander, rough-skinned newt, western red-backed salamander, ensatina, western toad, Pacific treefrog, red-legged frog, bullfrog, northern alligator lizard, western terrestrial garter snake, northwestern garter snake, and common garter snake (Hallock and Leonard 1997).

The shrubs, trees, and water found in wetlands and riparian corridors provide foraging, nesting, and rearing sites for rufous-sided towhees, swallows, American robins, ruffed grouse, red-winged blackbirds, cedar waxwings, and belted kingfishers. Wetlands and riparian corridors also provide habitat for waterfowl and a variety of other water-dependent birds found year-round at JBLM. Wetlands and riparian corridors are a source of food and cover for both upland- and wetland-associated mammals. Species typically found in wetland and riparian environments in the JBLM region include river otter, mink, muskrat, and beaver. Columbia black-tailed deer, black bear, raccoons, striped skunks, and spotted skunks are also frequent users of wetland and riparian corridors.

Approximately 620 acres of freshwater wetland and 260 acres of riparian/forested wetland habitat are found on the Nisqually National Wildlife Refuge, located northwest of JBLM. These habitats support wildlife that are similar in species composition to those found on JBLM. Over 20,000 waterfowl use the refuge during winter.

Estuarine and Marine Habitats. JBLM borders Puget Sound. Bird species attracted to the protected marine habitats of Puget Sound include seabirds, such as alcids, gulls, shearwaters, and phalaropes, and shorebirds, such as sandpipers, herons, and plovers. Pigeon guillemot and glaucous-winged gull are the primary seabirds commonly found nesting south of Whidbey Island and are the only breeding seabirds with nests found in highly industrial areas in Puget Sound (e.g., Commencement Bay near Tacoma).

Several marine mammal species may be found in the waters of southern Puget Sound, including harbor seal, Steller sea lion, California sea lion, river otter, Dall's porpoise, harbor porpoise, killer whale, minke whale, humpback whale, and gray whale. Marine mammals in Puget Sound are heavily dependent on good water quality, sufficient food, and undisturbed habitat for their health and survival. Five of these species are resident to Puget Sound: harbor seal, Dall's porpoise, harbor porpoise, killer whale, and minke whale. The other species are migratory (PSWQA and WDNR 1992).

The Nisqually River Delta, a biologically rich and diverse area at the southern end of Puget Sound and immediately northwest of JBLM, supports a variety of habitats. Here, the freshwater of the Nisqually River combines with the saltwater of Puget Sound to form an estuary rich in nutrients and detritus. These nutrients support a web of sea life, the benefits of which extend throughout Puget Sound and beyond. Together with McAllister and Red Salmon Creeks, the Nisqually River forms one of the largest remaining relatively undisturbed estuaries in Washington. Although most major estuaries in Washington have been filled, dredged, or developed, the estuary of the Nisqually River has been set aside especially for wildlife as the Nisqually National Wildlife Refuge (Figure 3-1). The Nisqually National Wildlife Refuge is home to thousands of waterfowl and other wildlife during fall through spring, and large numbers of migratory and resident birds and other wildlife

during all times of the year. Waterfowl, shorebirds, raptors, marsh and water birds all are attracted to the mosaic of habitats found on the Nisqually Delta.

3.8.1 No Action Alternative

Under the no action alternative, the RRPR test launch noise assessment would not occur.

3.8.2 Proposed Action – RRPR Noise Assessment Test Launch

The clearing of 1 acre of forest near the Hayes Hill firing point for trajectory clearance could result in a permanent loss of forested wildlife habitat on JBLM. Plant species and associated wildlife on the site would include species typically associated with lightly disturbed areas in the Puget Sound lowlands. The forested area that would be cleared is comprised of young mature deciduous and coniferous trees that likely provide habitat for a range of species. Harvest of trees could cause injury or mortality to low-mobility wildlife. Nesting birds and nestlings would not be harmed as the tree harvest and test launch would occur outside the nesting season.

Following timber harvest, it is predicted that the area would be rapidly colonized, predominantly by grasses and Scotch broom, an aggressive, invasive non-native species that is widespread in disturbed areas on JBLM. Therefore, the resulting plant community would be lower quality to wildlife than the forested community currently on the site. However, the loss of 1 acre would constitute a loss of less than 0.1 percent of the total forested habitat on the installation and would not be significant to wildlife.

The RRPR test launch would have the potential to cause impacts to wildlife and domestic animals. Noise from firing would include rocket ignition, rocket ejection from the launch tube, rocket motor noise, and the sonic boom. The first three noises would be heard in all directions from the launcher, but the sonic boom can only be heard forward of the launch site and inside an area within which the sonic boom propagates (mach angle; USACHPPM 1999). The effects of sonic booms on animals vary based on animals' hearing ability, which varies considerably among species (Manci et al. 1988).

As shown in Figures 3-2 and 3-3, peak modeled noise levels for firing of rockets are similar to those for large caliber weapons (such as 155-mm howitzers), which are currently fired regularly at Hayes Hill and other firing points on JBLM. RRPR peak noise levels greater than 130 dBP from would occur along the flight path of the rocket on JBLM. Much of the wildlife habitat on JBLM (including prairies and forests) would be exposed to lower peak noise levels from RRPRs than from large caliber weapons. Portions of the Nisqually National Wildlife Refuge are currently exposed to peak noise levels greater than 115 dBP from large caliber weapons training. According to noise modeling, the Nisqually National Wildlife Refuge would potentially be exposed to peak noise levels this high from rocket firing, thus wildlife would not be subject to greater peak noise levels during the 3-day test launch. Species that use these habitats are likely to have adapted to noise associated with military activities, and noise-related impacts to wildlife should not be significant.

A literature review conducted by the USFWS summarizes the results of studies of the effects sonic booms on the behavior and reproduction of domestic animals and wildlife (Manci et al. 1988). The following paragraphs discuss the results of numerous studies discussed in this literature review.

Domestic Animals. Studies on domestic animals indicate that although exposure to sonic booms may cause changes in behavior, it does not injure animals or affect reproductive success. Livestock showed startle reactions to sonic booms. Sonic booms had no effect on eating patterns, total feed intake, rate of feed intake, or milk production in dairy cows, or in semen quality or production of bulls. Excess secretion of hormones occurred in pigs subjected to sonic booms, but conception and feeding rates were unaffected by loud noises similar to those produced by sonic booms. Sonic booms and other loud noises led to increased heart rates in several species of domestic animals. Intense noises may affect the growth rate of chickens, but studies of hens exposed to simulated sonic booms in the laboratory showed no effects to oviposition, hatchability, viability, or hatching time, even when hens were exposed to over 600 sonic booms during the incubation period. Sonic booms, even at high intensities, did not crack the eggs of domestic chickens, and all chickens hatched normally (Stadelman 1958). Reproduction in domestic turkeys in the vicinity of Edwards Air Force Base, California, was not affected by sonic booms.

Reptiles and Amphibians. Reptiles and amphibians showed avoidance behavior to loud noises (Manci et al. 1988).

Birds. Waterfowl and other waterbirds were visibly disturbed by aircraft and often showed avoidance or escape responses, but sonic booms had little effect on their reproduction. Sonic booms caused some waterfowl to stop feeding and move more closely together, and occasionally take to flight, while other species showed no visible reaction to sonic booms (Rylander et al. 1974).

In one study, herring gulls responded intensively to sonic booms and many eggs were broken as birds flushed from their nests. The same sonic booms may have also led to the failure of a sooty tern colony (Burger 1981 *in* Manci et al. 1988). The songs of songbirds in Texas were silenced for 4 to 8 seconds before the arrival of a sonic boom, as birds were alerted to the sonic pressure wave before the sound was heard. Sonic booms agitate common ravens, who were observed gathering in groups after sonic booms (Manci et al. 1988).

In studies of mourning doves and passerines subjected to sonic booms from aircraft two or three times per week, there were no differences in reproduction between the exposed birds and a control group. In addition, subjecting laboratory-raised quail three times per day to pressures similar to those produced by sonic booms had no effects on hatching success, growth rates, or mortality (Teer and Truett 1973). Wild turkey tracked with radio collars showed alert behavior for about 30 seconds after exposure to a sonic boom, but did not show any behavior that would result in lowered productivity (Lynch and Speake 1975). Intense sonic booms flushed ground-dwelling birds at a refuge in Arizona, but most wildlife on the refuge appeared to habituate to the noise (Manci et al. 1988).

A study of the behavioral responses of raptors in the wild to sonic booms showed that sonic booms had little effect, even in test situations of 23 sonic booms per day. While the birds were often noticeably alarmed by the sonic booms, the responses were generally short and did not impact bird productivity. Birds generally resumed normal behavior within 30 seconds of the sonic boom. In

general, the birds were tolerant of stimulus loads that would likely be unacceptable to humans. Small nestlings showed less response to sonic booms than large nestlings or adults. Site abandonment was not observed during the study (Ellis 1981).

Terrestrial Mammals. Auditory damage was noted in lab mice exposed to simulated sonic booms. Blood clots were found in the ears of mice, and effects of multiple sonic booms were cumulative. The traces of bleeding cleared up after about 8 weeks. Mink exposed to three sonic booms within an hour showed no reproductive effects and no panic behavior (Travis et al. 1974 *cited in* Manci et al. 1988). Behavioral reactions were brief, lasting no more than 2 minutes, and most mink appeared to habituate to noise and vibrations after exposure to the three sonic booms.

Deer and other ungulates appear to be more sensitive to loud noises than domestic livestock. Startle responses were seen in reindeer subject to 36 sonic booms over 3 days, but panic reactions or extensive changes in behavior of individuals were not seen. Reindeer, bison, and caribou appeared more sensitive to aircraft approach than loud aircraft noise (Manci et al. 1988). In a study examining the effects of sonic booms on pronghorn, elk, and bighorn sheep, all three species exhibited an increase in heart rate lasting about 30 to 90 seconds, but this response decreased after successive sonic booms, suggesting that animals habituated to the noise (Workman et al. 1992). Bighorn sheep and pronghorn showed alert and startle responses and jumping and running to intense sonic booms (Manci et al. 1988).

Marine Mammals. Marine mammals often show startle responses to sonic booms, but studies of elephant seals and sea lions showed that animals returned to normal activity within a few minutes. No trampling of pups was seen in response to sonic booms, but over 70 percent of sea lions left haul out areas and went to the surfline after a sonic boom during the non-breeding season. Still, alert reaction lasted longer to a human intrusion than to a sonic boom (Manci et al. 1988). Sonic booms did not affect the breeding behavior of seals (Perry et al. 2002).

Invertebrates. There is little available literature on the effects of noise and sonic booms on invertebrates, including beneficial pollinators. Many of the past studies on this topic have been conducted to determine whether noise can be used to repel or kill insects (U.S. Environmental Protection Agency 1980). Literature reviews by the USEPA (1980) and Manci et al. (1988) briefly discuss effects of noise on invertebrates. The findings of these reviews suggest that insects have differing responses to noise, which vary based on the frequency of noise and the duration of the exposure. Effects ranged from attraction to certain noise to reduced reproduction and longevity, to flying, freezing (cessation of movement), or other behavioral responses. Studies in which notable adverse effects were observed involved continual exposure to loud noises. It is not expected that short, infrequent exposures to loud noises and sonic booms associated with rockets would lead to population-level effects to invertebrate species (including pollinators).

When viewed as a whole, these studies indicate that while sonic booms can disturb wildlife and domestic animals and alter their behavior, they are unlikely to cause injury or have reproductive effects that would constitute significant adverse effects to wildlife populations or domestic animals, including waterfowl and other wildlife at the Nisqually National Wildlife Refuge. In many cases, waterfowl are more disturbed by the approach of aircraft than by the associated loud noises and sonic booms.

During the noise assessment test launch, exhaust from RRPRs would be generated at the firing point. Exhaust from rockets contains small quantities of chemicals that can be hazardous in large quantities. Rocket motor exhaust components predominantly contain aluminum oxide, carbon monoxide, carbon dioxide, HCl, water, and nitrogen (98.08%). Of these emissions, carbon monoxide and HCl are of greatest concern to domestic animals and wildlife (Brown and Root Environmental 1996). Aluminum oxide has low toxicity to humans and likely would not impact wildlife (U.S. Air Force 1989 *in* Brown and Root Environmental 1996). Disturbance and noise at the launch site should discourage use of the launch site and nearby areas by birds and other wildlife while certification training is in progress. Impacts to domestic animals and livestock from rocket motor exhaust should not occur, since none would be near the firing point during launches.

The launching of RRPRs would be associated with a risk of fire at the launch site. Fires can cause mortality of sedentary species (such as butterfly larvae), and can indirectly affect a greater number of species through the loss of vegetative forage and cover. Risk of fire would be minimized by the fire management procedures discussed in Section 3.4.2. During the RRPR test launch, soldiers would check the launch sire for fires following the release of each rocket, and would quickly extinguish any that were present. With these procedures in place, it is expected that the risk of a fire escaping from the launch site and affecting wildlife or significant quantities of wildlife habitat would be minimal. Domestic animals would not be present in the vicinity of the launch site. Therefore it is not expected that significant effects to wildlife and domestic animals would occur.

3.9 Threatened, Endangered, and Sensitive Species

Numerous species in the JBLM region have been given a special status at the federal and/or state level, based on their risk of extirpation and decline (Table 3-7). The presence of several of these species has not been documented in the recent past, but potential habitat for these species does exist on the installation. In addition, some species occupy small territories or occur in isolated sites in Pierce or Thurston counties that are located outside the JBLM boundary. Federally listed species that could be found on or near JBLM, as well as the bald eagle and western gray squirrel, are discussed in more detail below. The yellow-billed cuckoo, leatherback sea turtle, Canada lynx, gray wolf, grizzly bear, and marsh sandwort are very unlikely to be found on or near JBLM and are not discussed any further in this section.

Table 3-7
Threatened, Endangered, and Sensitive Species that May Occur Within the Vicinity of the RRPR Test Launch Noise Assessment

Common Name	Scientific Name	Federal Status	State Status
Invertebrates			
Fender's soliperlan stonefly	*Soliperla fenderi*	SC	--
Mardon skipper	*Polites mardon*	C	E
Taylor's checkerspot	*Euphydryas editha taylori*	E	E
Valley silverspot	*Speyeria zerene bremeri*	SC	C
Reptiles and Amphibians			
Larch mountain salamander	*Plethodon larselli*	SC	S
Leatherback sea turtle[1]	*Dermochelys coriacea*	E	E
Northwestern pond turtle	*Clemmys marmorata marmorata*	SC	E
Oregon spotted frog	*Rana pretiosa*	T	E
Rocky Mountain tailed frog	*Ascaphus truei*	SC	C
Van Dyke's salamander	*Plethodon vandykei*	SC	C
Western toad	*Bufo boreas*	SC	C
Fish			
Bocaccio	*Sebastes paucispinis*	E	C
Canary rockfish	*Sebastes pinniger*	T	C
Coastal/Puget Sound Bull Trout	*Salvelinus confluentus*	T	C
Eulachon	*Thaleichthys pacificus*	T	C
Green sturgeon	*Acipenser medirostris*	T	--
Puget Sound Chinook	*Oncorhynchus tshawytscha*	T	C
Puget Sound Steelhead	*Oncorhynchus mykiss*	T	--
Yelloweye rockfish	*Sebastes ruberrimus*	T	C
Birds			
Bald eagle	*Haliaeetus leucocephalus*	SC	S
Common loon	*Gavia immer*	--	S
Marbled murrelet	*Brachyramphus marmoratus*	T	T
Northern goshawk	*Accipiter gentilis*	SC	C
Northern spotted owl	*Strix occidentalis caurina*	T	E
Oregon vesper sparrow	*Pooectetes gramineus affinis*	SC	C
Peregrine falcon	*Falco peregrinus*	SC	S
Pileated woodpecker	*Dryocopus pileatus*	--	C
Purple martin	*Progne subis*	--	C
Slender-billed, white breasted nuthatch	*Sitta carolinensis aculeata*	SC	C
Streaked horned lark	*Eremophila alpestris strigata*	T	E
Yellow-billed cuckoo[1]	*Coccyzus americanus*	T	C
Mammals			
Canada lynx[1]	*Lynx canadensis*	T	T
Gray wolf[1]	*Canis lupus*	E	E
Grizzly bear[1]	*Ursus arctos*	T	E
Humpback whale	*Megaptera novaeangliae*	E	E
Mazama pocket gopher	*Thomomys mazama*	T	T
Northern sea otter	*Enhydra lutris kenyoni*	SC	E
Pacific Townsend's big-eared bat	*Corynorhinus townsendii townsendii*	SC	C
Southern resident killer whale	*Orcinus orca*	E	E
Western gray squirrel	*Sciurus griseus griseus*	SC	T
Plants			
Golden Paintbrush	*Castilleja levisecta*	T	
Marsh Sandwort[1]	*Arenaria paludicola*	E	
Water Howellia	*Howellia aquatilis*	T	

E = endangered; T = threatened; C = candidate; S = sensitive; and SC = species of concern.
[1] Species occurs on USFWS lists, but is not known to occur in the region currently.
Sources: NMFS (2015); USFWS (2015); and WDFW (2015).

3.9.1 Taylor's checkerspot butterfly

The historical range of the Taylor's checkerspot butterfly extended from the southern tip of Vancouver Island in British Columbia and other smaller adjacent islands south through the Puget Trough and north Olympic Mountains to the Willamette Valley in Oregon (Stinson 2005). The Taylor's checkerspot butterfly is a resident, non-migratory butterfly species. As of 2009, it had been documented from a total of 14 distinct populations, including eleven in Washington, two in Oregon, and one in Canada. JBLM contains the largest colony of Taylor's checkerspot butterflies in Washington, located almost entirely within the AIA. Other colonies of this species have been extirpated at several locations on JBLM where they once occurred (Wolford et al. 2008).

3.9.1.1 No Action Alternative

Under the no action alternative, the RRPR test launch noise assessment would not occur. The Taylor's checkerspot butterfly will continue to be managed in accordance with the JBLM Integrated Natural Resources Management Plan.

3.9.1.2 Proposed Action – RRPR Noise Assessment Test Launch

Direct effects associated with the RRPR test launch noise assessment are primarily focused on the noise generated from weapon firing, as well as the impact of the rocket when it lands within the AIA. There are fire risks associated with RRPR firing, but this risk would be limited to the Hayes Hill firing point and would not impact the AIA. Taylor's checkerspot butterflies do not occur in the Training Area 4/Hayes Hill area, thus there would be no direct effects to butterflies at the RRPR launch site. There is a potential for disturbance in the AIA, although the target area where the RRPRs would land does not currently support any known populations of checkerspots.

3.9.2 Oregon spotted frog

Oregon spotted frogs are highly aquatic and live in or near permanent bodies of water, including lakes, ponds, slow streams, and marshes. They are most often found in non-woody wetland plant communities that support such vegetation as sedges, rushes, and grasses. Oregon spotted frogs were collected near JBLM during the early 20th century and at least one historic site once existed on JBLM, but no Oregon spotted frogs were detected during extensive surveys conducted in the early 1990s. A population in the Black River watershed in Thurston County, which is 12 miles southwest of JBLM, is the only known extant population in the lowlands of western Washington and Oregon (McAllister 1995 and McAllister and Leonard 1990). A reintroduction project was started at Dailman Lake on JBLM in 2008. As of November 2012, about 5,490 frogs from the captive rearing project have been released into Dailman. Evidence of breeding by the reintroduced population was found in April 2011 when three verified Oregon spotted frog egg masses and eleven egg masses suspected to be Oregon spotted frogs were found by WDFW and JBLM biologists.

3.9.2.1 No Action Alternative

Under the no action alternative, the RRPR test launch noise assessment would not occur. The Oregon spotted frog will continue to be managed in accordance with the JBLM Integrated Natural Resources Management Plan

3.9.2.2 Proposed Action – RRPR Noise Assessment Test Launch

Dailman Lake, where Oregon spotted frogs have been reintroduced on JBLM, is located outside the predicted 115-130 dBP noise contour. Amphibians are sensitive to noise, but there is little information on the effects of sonic booms on amphibians. Based on studies of fish, which are similar in many regards to amphibians, it is unlikely that eggs, tadpoles, or adult Oregon spotted frogs would be impacted by the RRPR test launch.

3.9.3 Bull trout

Bull trout are native to the Pacific Northwest and western Canada, and were federally listed as a threatened species on June 10, 1998 (Federal Register 1998). Historically, bull trout were found throughout the Pacific Northwest including Montana, Idaho, northern California, Washington and Nevada (Knowles and Gumtow 2005). They exhibit both resident and migratory life-history strategies throughout much of their current range (Rieman and McIntyre 1993).

Bull trout historically were present in the Nisqually River, and there have been recent sightings in the Nisqually River, which have likely been foraging bull trout (Chan 2000, 2003, Ellings 2004). A single juvenile was collected during stream sampling in the lower reaches of the Nisqually River in the mid-1980s (Washington Department of Fish and Wildlife 1998a), and in the late 1990s a single adult was observed at Clear Creek Fish Hatchery in mid-September (USFWS 2004a). In July 2004, a bull trout was collected in the lower reaches of the Nisqually River (Fort Lewis Public Works 2006). Bull trout are most likely to be found in the Nisqually River during the winter and spring months, but are unlikely to be found there later in the summer and fall when they journey upstream into glacial streams to spawn. In 1996, a study was conducted to determine the presence of bull trout and potential habitat on JBLM. Cabin, Sequalitchew, and Murray Creeks were surveyed for bull trout presence. Muck and Clear creeks were not surveyed because they did not contain suitable habitat for bull trout. The survey did not locate any populations of bull trout on JBLM (Fort Lewis Public Works 2006).

On September 25, 2005, the USFWS designated critical habitat for the Coastal-Puget Sound Distinct Population Segment of bull trout, including 1,212 miles of stream and marine shoreline in the Puget Sound region (Federal Register 2005). JBLM water bodies are exempt from this critical habitat designation.

3.9.3.1 No Action Alternative

Under the no action alternative, the RRPR test launch noise assessment would not occur. Bull trout or its habitat is not known to exist on JBLM.

3.9.3.2 Proposed Action – RRPR Noise Assessment Test Launch

The closest body of water to the launch site where bull trout could occur is the Nisqually River (7,400 feet). It is unlikely that any rockets fired would land in the Nisqually River and residue from the launch site would most likely dissipate prior to reaching the river.

A study of salmon hearing determined that salmon are unlikely to detect sounds originating in the air, and that their hearing is masked by the turbulence in their river habitat (Popper and Clarke 1976). Based on this information, it is not expected that noise associated with the RRPR test launch would have an adverse effect on bull trout.

3.9.4 Puget Sound Chinook

This species is found from the Bering Strait south to southern California. The Puget Sound Evolutionary Significant Unit (ESU) for Chinook salmon is federally listed as threatened. The Nisqually River maintains a summer/fall stock of the Puget Sound ESU of Chinook salmon. Adults enter the river from July through September, with peak spawning occurring in mid-October (Nisqually River Council 2001). Seaward migration of Nisqually Chinook is assumed to be predominantly in the spring and summer of the first year of freshwater residence. Historically, there was a spring component in the Nisqually River, but these runs were last observed in the early 1950s, and the ESU is now considered extinct from this river.

On September 2, 2005, NMFS designated critical habitat areas in Washington for Puget Sound Chinook salmon (Federal Register 2005). However, none of the streams on JBLM are classified by NMFS as critical habitat for Chinook salmon.

3.9.4.1 No Action Alternative

Under the no action alternative, the RRPR test launch noise assessment would not occur. Chinook salmon or its habitat is not known to exist on JBLM.

3.9.4.2 Proposed Action – RRPR Noise Assessment Test Launch

The closest body of water to the launch site where Chinook could occur is the Nisqually River (7,400 feet). It is unlikely that any rockets fired would land in the Nisqually River and residue from the launch site would most likely dissipate prior to reaching the river.

A study of salmon hearing determined that salmon are unlikely to detect sounds originating in the air, and that their hearing is masked by the turbulence in their river habitat (Popper and Clarke 1976). Based on this information, it is not expected that noise associated with the RRPR test launch would have an adverse effect on Chinook.

3.9.5 Puget Sound steelhead

The original range of steelhead was from northern Mexico to southeastern Alaska, and inland to the tributaries of the upper Columbia River, to Hell's Canyon Dam on the Snake River and the Clearwater and Salmon rivers in Idaho. Puget Sound ESU steelhead are present in most drainages

of Puget Sound, coastal streams, and the lower Columbia River. The Nisqually River has both winter- and summer-run steelhead (Hiss et al. 1982). The winter run consists of both native fish and hatchery fish of outside origin, but is managed for natural production. This run contributes to both the Nisqually Indian commercial and non-Indian sport fisheries on the Nisqually River. The summer run consists of hatchery fish of outside origin and contributes to a small non-Indian sport fishery on the river. Muck creek provides rearing habitat for winter steelhead (Salmonscape 2015). Hatchery plants of both winter and summer steelhead have occurred historically in the basin, but have been eliminated to protect the native wild stock (Fort Lewis Public Works 2006). Spawning occurs from April through June, with fry emerging from late May through August.

Final critical habitat designations for steelhead in the Pacific Northwest were made final on August 15, 2005; these designations only apply to Columbia River steelhead ESUs. All military areas are excluded. In the Northwest, these exclusions total 29 stream miles and 48 shoreline miles in Puget Sound.

3.9.5.1 No Action Alternative

Under the no action alternative, the RRPR test launch noise assessment would not occur. Puget Sound steelhead will continue to be managed in accordance with the JBLM Integrated Natural Resources Management Plan.

3.9.5.2 Proposed Action – RRPR Noise Assessment Test Launch

The closest body of water to the launch site (Nisqually River) is 7,400 feet and the targeted area within the AIA is roughly 5,000 feet from the nearest body of water (Muck Creek). It is unlikely that any rockets fired would land in either Muck Creek or the Nisqually River. Residue from the launch site or impact area would most likely dissipate prior to reaching either Muck Creek or the Nisqually River.

A study of salmon hearing determined that salmon are unlikely to detect sounds originating in the air, and that their hearing is masked by the turbulence in their river habitat (Popper and Clarke 1976). Based on this information, it is not expected that noise associated with the RRPR test launch would have an adverse effect on steelhead.

3.9.6 Rockfish

Bocaccio

Bocaccio are very rare in the Puget Sound, and have declined substantially since 1965, particularly relative to other rockfish species in the Puget Sound. The occurrence of large adult bocaccio in the Georgia Basin appears to be limited to certain areas. In past years, they were most commonly caught in the areas around Point Defiance and the Tacoma Narrows in the South Puget Sound. Based on limited information, they are frequently found in areas lacking hard substrates. Copulation and fertilization typically occur between August and November. Larvae are planktivores, pelagic juveniles are opportunistic feeders, and larger juveniles and adults are primarily piscivores. The main predators of adult bocaccio are marine mammals. Threats to the Georgia Basin DPS of bocaccio include low dissolved oxygen within their range, bycatch in

recreational and commercial harvest, and a reduction in kelp habitat necessary for juvenile recruitment.

Yelloweye Rockfish

Yelloweye rockfish occur from Baja California to Alaska. They are distributed throughout the Strait of Georgia in the northern Georgia Basin, but are less frequently observed in South Puget Sound. They typically occur in waters 80 to 1,560 feet (25 to 475 meters) deep, and often occur in areas with high relief and complex rocky habitats. Juveniles settle in shallow, high relief zones, crevices, and sponge gardens, and then move to deeper waters as they grow. Fertilization may occur throughout the year, but is most common between September and April. Yelloweye rockfish are opportunistic feeders. Early life stages eat foods similar to those described for bocaccio. Adult yelloweye rockfish are larger than adult bocaccio, and tend to eat sand lance, gadids, flatfishes, shrimps, crabs, and gastropods. Predators include salmon and orcas. Threats to the species include low intrinsic productivity, bycatch in recreational and commercial harvest, loss of near shore habitat, chemical contamination, and areas of low dissolved oxygen.

Canary Rockfish

Canary rockfish range from Baja California to the Western Gulf of Alaska, but are most common off the coast of central Oregon. They were once considered fairly common in the greater Puget Sound area. They inhabit waters 160 to 820 feet (50 to 250 meters) deep, and are associated with the various rocky and coarse habitats throughout the basins of the Puget Sound. Fertilization peaks in December, and spawning occurs once per year. Larvae are planktivores, juveniles are zooplanktivores, and adults are planktivores/carnivores. Predators include yelloweye rockfish, lingcod, salmon, sharks, dolphins, seals, and possibly river otters. Threats to the species include low intrinsic productivity, bycatch in recreation and commercial harvest, loss of near shore habitat, chemical contamination, and areas of low dissolved oxygen.

3.9.6.1 No Action Alternative

Under the no action alternative, the RRPR test launch noise assessment would not occur. Rockfish is not known to exist on JBLM.

3.9.6.2 Proposed Action – RRPR Noise Assessment Test Launch

If rockfish are present in Puget Sound in the vicinity of JBLM during the RRPR test launch, they would be located in the audible (<115dBP) noise contour. No effect to rockfish is expected from the RRPR test launch noise assessment.

3.9.7 Green sturgeon

Green sturgeon are long-lived, slow-growing fish, and are the most marine-oriented of the sturgeon species. Green sturgeon are believed to spend the majority of their lives in nearshore oceanic waters, bays, and estuaries. Green sturgeon do not spawn in Washington (NMFS 2013). Juvenile green sturgeon spend one to three years in fresh and estuarine waters before they leave for saltwater, where they disperse widely in the ocean. Kelly et al. (2007) found that foraging adult and subadult sturgeon in San Francisco and San Pablo Bays remained primarily in waters less than 33 feet in depth, moving on and off of shallow flats with the tidal fluctuations. Only larger

juveniles, subadults, and adults are expected to be found in Puget Sound due to the distance from natal streams. The area near JBLM could be used for foraging.

The southern DPS of green sturgeon was federally listed as threatened in April 2006 (NMFS 2006). Critical habitat was designated in 2009 and does not include Puget Sound (NMFS 2009).

3.9.7.1 No Action Alternative

Under the no action alternative, the RRPR test launch noise assessment would not occur. Green sturgeon is not known to exist on JBLM.

3.9.7.2 Proposed Action – RRPR Noise Assessment Test Launch

If foraging green sturgeon are present in Puget Sound during the RRPR test launch, they would be located in the notable (115-130 dBP) or audible (<115dBP) noise contour. No effect to green sturgeon is expected from the RRPR test launch noise assessment.

3.9.8 Eulachon

Pacific eulachon are endemic to the eastern Pacific Ocean, with a range from northern California to Southwestern Alaska and into the Bering Sea. South of the U.S./Canada border, most eulachon production originates in the Columbia River Basin. Eulachon have also been documented, infrequently, in coastal rivers and tributaries to Puget Sound in Washington (Emmett et al. 1991, Musick et al. 2000).

The southern DPS of eulachon was federally listed as threatened on March 18, 2010 (NMFS 2010). Critical habitat was designated in 2011 and only includes portions of the Elwha and Quinault Rivers in Washington State (NMFS 2011).

3.9.8.1 No Action Alternative

Under the no action alternative, the RRPR test launch noise assessment would not occur. Eulachon is not known to exist on JBLM.

3.9.8.2 Proposed Action – RRPR Noise Assessment Test Launch

As eulachon are highly unlikely to be in the vicinity of the RRPR test launch, no effect to eulachon is expected.

3.9.9 Marbled murrelet

The marbled murrelet is a marine bird species that nests on large-diameter upper branches of coniferous trees in older forests along the marine coast and inland up to approximately 40 miles (Hamer and Cummins 1991). Murrelets are usually found in marine areas with mature forests nearby to provide nesting habitat (Washington Department of Wildlife 1993). The greatest concentration of marbled murrelets in Washington is found in northern Puget Sound.

Marbled murrelets are not known to occur on JBLM. Surveys have been conducted twice at JBLM (Bottorff et al. 1991, 1992), and though birds were observed near JBLM on the Nisqually River and in the Puget Sound area near Solo Point, none were found on the installation itself. Marbled murrelet critical habitat has been designated in Pierce County (USFWS 2004b); however, this habitat is located primarily in late-succession reserve forests on federal land in the Cascade Range, in the eastern section of the county. There is no critical habitat designation within JBLM.

3.9.9.1 No Action Alternative

Under the no action alternative, the RRPR test launch noise assessment would not occur. The marbled murrelet is not known to exist on JBLM.

3.9.9.2 Proposed Action – RRPR Noise Assessment Test Launch

Marbled murrelets use areas adjacent to JBLM primarily along the shoreline of Puget Sound, with a few birds using the mouth of the Nisqually River. Based on past surveys there is no evidence that murrelets use forests on JBLM for nesting. Puget Sound in the vicinity of JBLM does not appear to provide high-value habitat for marbled murrelets and there is no potential nesting habitat in the vicinity of the proposed launch site or in the AIA. Therefore, the RRPR test launch would not affect marbled murrelets.

3.9.10 Northern spotted owl

The Northern spotted owl is associated with most of the major types of coniferous forest in the Pacific Northwest. Suitable habitat for the species on JBLM was identified and mapped by the USFWS, and in 1992, 62,000 acres of JBLM were designated as critical habitat for Northern spotted owl (USFWS 1991). Based on a 2008 ruling by the U.S. Fish and Wildlife Service, however, the areas previously designated as critical habitat for the Northern spotted owl on the installation have been removed as part of the overall critical habitat revision for this species (Federal Register 2008). JBLM is considered a strategic location between known spotted owl populations on the Olympic Peninsula to the west and the Cascade Range to the east.

Surveys for Northern spotted owls using calling stations on JBLM were conducted during nine years between 1991 and 2008 (USFWS 1991; Raedeke and Associates, Inc. 1995; Malkin 1999; ENSR 2003, 2006). No spotted owls were detected during these surveys. JBLM has prepared a management plan that will encourage management of forestlands to develop the characteristics of Northern spotted owl habitat (Bottorff and Rhode 1994).

3.9.10.1 No Action Alternative

Under the no action alternative, the RRPR test launch noise assessment would not occur. The Northern spotted owl and its habitat will continue to be managed in accordance with the JBLM Integrated Natural Resources Management Plan.

3.9.10.2 Proposed Action – RRPR Noise Assessment Test Launch

Northern spotted owls do not occur on JBLM, but forests on the installation could provide habitat for the species in the future, and until recently were considered critical habitat (Federal Register 2008). Most of the forested habitat that would be cleared for RRPR trajectory clearance consists of pole and young mature stands, and provides no suitable habitat for northern spotted owl. This clearing would constitute a fraction of a percent of the total forests on JBLM. Additionally, JBLM manages its forests to improve habitat characteristics that make it more suitable for northern spotted owls. Therefore, the proposed tree harvest would not affect northern spotted owl.

3.9.11 Streaked horned lark

The streaked horned lark, one of the four breeding subspecies of horned lark in Washington, breeds in the lowlands of western Washington, in remnant grasslands on prairies and beaches (Smith et al. 1997). Streaked horned larks have declined with the loss of prairie habitats to development and succession to forest. With the cessation of burning of the prairies by Native Americans, Douglas-fir has spread over much of the prairie and introduced grasses, weeds, and Scotch broom have degraded much of the remainder. Streaked horned larks may have also been restricted to portions of the prairie where the vegetation was short and sparse due to excessive dryness or repeated burns (Stinson 2005). At present, known breeding locations of streaked horned larks within the vicinity of the installation include JBLM and the Olympia Airport in Thurston County (Pearson 2003, Pearson and Hopey 2005). On JBLM, streaked horned larks currently breed on Gray Army Airfield, McChord Airfield, Training Areas 14 and 31, and in the AIA.

3.9.11.1 No Action Alternative

Under the no action alternative, the RRPR test launch noise assessment would not occur. The streaked horned lark will continue to be managed in accordance with the JBLM Integrated Natural Resources Management Plan.

3.9.11.2 Proposed Action – RRPR Noise Assessment Test Launch

There are no direct effects anticipated for streaked horned lark for the proposed RRPR test launch. The proposed noise assessment test launch would occur in winter. Streaked horned lark have the potential to be present at JBLM from February to October, with the highest probability occurring within the summer months. Streaked horned lark are a migratory bird known to fly south (Willamette Valley) in the winter months. They are not known to be present within Pierce County from November to January. It is highly unlikely that streaked horned larks would be present during the RRPR test launch, thus the proposed action would have no effect on streaked horned lark. In addition, the existing Hayes Hill forested area does not provide suitable habitat for streaked horned lark, so no effects to habitat would result from the launch site tree clearing activities.

3.9.12 Bald eagle

On July 28, 2007, the USFWS delisted bald eagles that inhabit the lower 48 states because the species was meeting or exceeding established recovery goals throughout its range. However, the bald eagle is still protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act.

Bald eagles are year-round residents on JBLM. Upwards of 270 bald eagles may winter on the installation (Stalmaster and ENSR 2006). During the last decade, numbers of both nesting and wintering bald eagles on JBLM have increased, a trend that has been observed throughout the South Puget Sound region (Stinson et al. 2007). Food supplies are the most important factor in maintaining the wintering population at JBLM (Stalmaster 1992, Stalmaster and ENSR 2006). Additional concerns are the maintenance of habitat near and within extensively used roost sites and foraging areas, particularly along Muck Creek and Carter Woods along the Nisqually River, and disturbance factors that could preclude bald eagles from using suitable habitat.

In a study of wintering eagle response to military activities at JBLM, Stalmaster and Kaiser (1997) reported that, although some sensitive eagles left the area during firing, most were not overly disturbed by artillery and small arms fire. Habituation to regular events and the need for the food and habitat on JBLM presumably caused eagles to be tolerant of firing exercises. Heavy artillery impacts as close as 1 km were tolerated, but low helicopter overflights and close boat encounters caused most eagles to flush. Military activities at JBLM were not disruptive enough to preclude high eagle use of the area.

3.9.12.1 No Action Alternative

Under the no action alternative, the RRPR test launch noise assessment would not occur. The Bald eagle will continue to be managed in accordance with the JBLM Integrated Natural Resources Management Plan.

3.9.12.2 Proposed Action – RRPR Noise Assessment Test Launch

The test launch is scheduled for the January/February timeframe, noise from the RRPRs would have the potential to disturb wintering bald eagles. Nearly all wintering bald eagles on the installation are migratory transients. Wintering bald eagles have little time to habituate to many military activities and are therefore less predictable in their responses. The most likely effects to wintering eagles include avoidance flights and disruptions of feeding, which are both counter to the eagles' winter adaptive strategy of maximizing energy gain and minimizing energy loss (Stalmaster and Kaiser 1998). However, since the test launch would only occur over a 3-day period, displaced eagles could return to the area following completion of the noise assessment.

3.9.13 Mazama pocket gopher

The Mazama pocket gopher is a regional endemic found only in western Washington, western Oregon and northern California (Stinson 2005). Mazama pocket gophers are known to persist at 27 sites scattered across the southern Puget Sound grasslands and alpine meadows of the Olympics. These may total in the low thousands, but many are small populations on marginal sites that are unlikely to persist. Most gopher populations are restricted to grassland on remnant and former prairie sites. Mazama pocket gophers are not constrained to live on native vegetation and will eat many introduced grasses and weedy forbs. Soil type seems to affect their distribution, because they are absent from most prairies with particularly rocky soils. On JBLM, Mazama pocket gophers are known to occur at several grassland locations including the edges of the AIA, firing ranges in

the South Impact Area, and various other prairies on the installation (e.g., Training Area 6 prairie, Marion, Johnson, and all three Weir prairies).

3.9.13.1 No Action Alternative

Under the no action alternative, the RRPR test launch noise assessment would not occur. The Mazama pocket gopher will continue to be managed in accordance with the JBLM Integrated Natural Resources Management Plan.

3.9.13.2 Proposed Action – RRPR Noise Assessment Test Launch

Mazama pocket gophers are not found in the Hayes Hill area, thus there would be no effect to gophers at the RRPR firing point. Noise from rocket firing could disturb gophers, and the impact of the rocket nose cone in the AIA could harm or kill gophers. Since the RRPRs are non-explosive on impact, there would be no ground crater formed, destroying gopher habitat. Given that the RRPR test launch would only be 3 days and the RRPRs are non-explosive, impacts to Mazama pocket gopher are unlikely to have an impact.

3.9.14 Humpback whale

The humpback whale is distributed worldwide in all ocean basins, though in the North Pacific it does not occur in Arctic waters (National Marine Fisheries Service 2008). In winter, most humpback whales occur in the subtropical and tropical waters of the Northern and Southern Hemispheres. The North Pacific population was considerably reduced as a result of intensive commercial exploitation during the 20th century and recovery has been very slow. Studies indicate that humpback whales from the Western and Central North Pacific mix on summer feeding grounds in the central Gulf of Alaska and perhaps the Bering Sea. No critical habitat has been designated for humpback whales. Humpback whales are rarely seen in southern Puget Sound (ENSR 1998).

3.9.14.1 No Action Alternative

Under the no action alternative, the RRPR test launch noise assessment would not occur. The Humpback whale does not exist on JBLM.

3.9.14.2 Proposed Action – RRPR Noise Assessment Test Launch

The RRPR test launch is scheduled to occur in winter when humpback whales are not present in Puget Sound, thus there would be no effect to this species.

3.9.15 Southern resident killer whale

Killer whales are the most widely distributed cetacean (e.g., whales, dolphins, and porpoises) species in the world (National Marine Fisheries Service 2008b). Killer whales are highly social animals that occur primarily in pods, or groups, of up to 50 animals. The Southern Resident killer whale population contains three pods (or stable family-related groups), and is considered a stock under the Marine Mammal Protection Act. The range of killer whales during the spring, summer, and fall includes the inland waterways of Puget Sound, Strait of Juan de Fuca, and Southern

Georgia Strait. Their occurrence in the coastal waters off Washington has been documented. The Southern Resident killer whale population is currently estimated at about 80 whales, a decline from its estimated historical level of about 200 during the mid- to late 1800s (NMFS 2015). Critical habitat has been designated in most of Puget Sound, including along JBLM, and along the northern Washington coast.

3.9.15.1 No Action Alternative

Under the no action alternative, the RRPR test launch noise assessment would not occur. The Southern resident killer whale does not exist on JBLM.

3.9.15.2 Proposed Action – RRPR Noise Assessment Test Launch

The proposed firing point for the RRPR test launch is over two miles from Puget Sound, thus there would be no effect on southern resident killer whales from the proposed action.

3.9.16 Western gray squirrel

The western gray squirrel is found in three areas within Washington: the Puget Trough (primarily JBLM), north-central Washington (Okanogan and Chelan counties), and south-central Washington (Klickitat and Yakima counties) (Ryan and Carey 1995). Its primary habitat in these areas is in oak-conifer woodlands, particularly those containing large ponderosa pines. These habitats are being replaced by conifers, agricultural lands, and development, limiting the squirrel to small, scattered populations. On JBLM, pockets of squirrels occur in mixed conifer and oak or pine woodlands that are adjacent to water sources (DPW 2006). Past records and observations, compared to recent monitoring efforts and surveys, show that the population on JBLM has declined dramatically in the last decade. Factors impacting squirrel declines on JBLM include automobile traffic, food availability, and possibly disease (Ryan and Carey 1995). Annually, JBLM averages three to four western gray squirrel deaths per year due to vehicles (DPW 2006). In 2007, WDFW and JBLM engaged in a cooperative study of the ecology of western gray squirrels on the installation and implemented a plan to augment this endangered population (Vander Haegen et al. 2007). Translocated squirrels were released into several large training areas that are used for military training periodically each year. The areas currently occupied by western gray squirrels on JBLM occur primarily within training areas and researchers have no reason to believe there are significant negative effects from these activities (Vander Haegen et. al. 2007). During 2010 surveys, researchers found that Western gray squirrel deaths were due to depredation, infection/disease, and physical trauma (Vander Haegen and Orth 2011).

3.9.16.1 No Action Alternative

Under the no action alternative, the RRPR test launch noise assessment would not occur. The western gray squirrel will continue to be managed in accordance with the JBLM Integrated Natural Resources Management Plan.

3.9.16.2 Proposed Action – RRPR Noise Assessment Test Launch

The 1-acre forested area to be harvested for RRPR trajectory clearing does not contain any known western gray squirrel nests or oak woodland habitat preferred by the species. Also, western gray squirrels are periodically subjected to military training activities with similar noise levels that would be produced by the RRPR test launch. Thus, no adverse effects to western gray squirrel are expected from the test launch noise assessment

3.9.17 Golden paintbrush

The golden paintbrush is a perennial herb that occurs in open grasslands at elevations below 328 feet (100 m) around the periphery of the Puget Trough. Most populations occur on glacially derived soils. Associated species include Roemer's fescue, red fescue, camas, common velvetgrass, yarrow, bracken fern, vetch, and brome (Gamon 1995). Many populations of this species have been extirpated by conversion of habitat to agricultural, residential, and commercial development.

The golden paintbrush was federally listed as threatened on June 11, 1997. Critical habitat has not been designated. In Washington, golden paintbrush is listed as a state endangered species. The USFWS lists the golden paintbrush as a species that may occur on JBLM. JBLM contains suitable habitat for this species, but several surveys have failed to find it (Army 2001c, e). However, six native grasslands near JBLM, all of which are Army Compatible Use Buffer (ACUB) areas, have experimental, introduced populations of this species (Dunwiddie 2009).

3.9.17.1 No Action Alternative

Under the no action alternative, the RRPR test launch noise assessment would not occur. The Golden paintbrush will continue to be managed in accordance with the JBLM Integrated Natural Resources Management Plan.

3.9.17.2 Proposed Action – RRPR Noise Assessment Test Launch

The nearest known population of this species is located south of Olympia in Thurston County. Actions occurring under the proposed RRPR test launch would not affect off-post populations of the species, since there would be no ground disturbances outside the installation boundary. Since golden paintbrush is not known to exist on JBLM, the proposed project would have no effect on this species.

3.9.18 Water howellia

Water howellia is a self-pollinated, annual aquatic plant that was federally listed as a threatened species on July 14, 1994 (USFWS 1994). No critical habitat has been designated for the species. In Washington, water howellia is listed as a state threatened species. Its historical range consists of five states in the Northwest United States: California, Idaho, Montana, Oregon, and Washington. In Washington, water howellia has been reported in Clark, Spokane, Pierce, and Thurston counties. The population has declined due to competition with introduced plants, loss of wetland habitat, and changes in habitat caused by timber harvesting, livestock grazing, and residential development.

Water howellia was first discovered on JBLM in 1994. During surveys in 2003 and 2004, 22 wetlands on the Main Post were identified as occupied by water howellia (Lynch 2005). These wetlands occur within the Ammunition Storage Area and in TAs 6, 8, 11, 12, and 13. These populations have been monitored since 1998 and appear to be stable (Gilbert 2002). All areas that could potentially contain water howellia were identified during these surveys, although all wetlands are considered to have potential habitat. Other occurrences of water howellia in the region include two locations at McChord AFB, one location in Thurston County, and one location in Clark County.

3.9.18.1 No Action Alternative

Under the no action alternative, the RRPR test launch noise assessment would not occur. Water howellia will continue to be managed in accordance with the JBLM Integrated Natural Resources Management Plan.

3.9.18.2 Proposed Action – RRPR Noise Assessment Test Launch

Fire risk associated with the RRPR test launch would be limited to the launch site. This site does not contain populations of water howellia, and it is far enough removed from populations that containment of any fires would occur before they reached any sites containing water howellia. Thus no adverse effects to water howellia are anticipated from the RRPR test launch.

3.10 Vegetation

The Hayes Hill firing point located in Training Area 4 primarily consists of coniferous forest, dominated by Douglas-fir trees of average diameter at breast height (dbh) of 33 inches. Understory species primarily include Cascade barberry, swordfern, and scattered herbaceous species.

The AIA primarily consists of prairie habitat, which is the result of frequent low intensity fires that are started by military training activities and limited vehicular traffic. These fires closely mimic historic anthropogenic fire regimes and help to maintain this prairie in a relatively high quality condition by reducing encroachment of Douglas-fir and controlling Scot's broom infestations.

3.10.1 No Action Alternative

Under the no action alternative, no change in vegetation disturbance would occur. JBLM vegetation will continue to be managed in accordance with the Integrated Natural Resources Management Plan and the Forest Management Plan.

3.10.2 Proposed Action – RRPR Noise Assessment Test Launch

To accommodate RRPR trajectory clearance, about one acre of forested area (~56 trees) would need to be harvested from Training Area 4 (Hayes Hill) to create a 120 meter (393 feet) wide clearance zone from the firing point extending directly downrange in the direction of the AIA. The forested communities that would be cleared are not unique or high quality plant communities, and similar forests are prevalent on the installation. Depending on the results of the noise assessment, the clearing of 1 acre would result in either a temporary or a permanent loss of forested habitat on

JBLM. If the noise assessment data is deemed excessive, trees would be replanted in the 1-acre cleared area. However, if it is not replanted, it is predicted that the area would be colonized by grasses and Scotch broom, an aggressive, invasive non-native species that is widespread in disturbed areas on JBLM. Therefore, the resulting plant community would be of lower quality than the forested community currently on the site, and would need to be maintained for training purposes. However, the loss of 1 acre would not be significant as this loss would only constitute a fraction of a percent of the 50,000 acres of forested habitat on JBLM.

As discussed in Section 3.4.2, there would be some risk of fire in and around the firing point during the RRPR test launch. Such a fire could damage vegetation on and around the launch site, and in an extreme case could spread into nearby forested habitat and burn through forest stands. Risk of fire would be minimized by checking the firing point for fires after every rocket launch and quickly extinguishing them, as well as through other fire management practices. Firebreaks would help contain fires to prevent their spread over a large area or off the installation. Overall, risks to vegetation near the firing point would be minor. There would be no risk of fire in the AIA since the RRPRs are non-explosive on impact.

Plants growing near the firing point could potentially be exposed to rocket combustion products such as aluminum compounds and hydrochloric acid, either directly on their growing surfaces or in the soil. Although the quantities of these compounds would be very small, it is possible that plants could be adversely affected. Potential effects would be limited to vegetation in a small area that has already been disturbed. Therefore, effects to vegetation would be negligible to minor.

3.11 Human Health and Safety

Concerns regarding human health and safety are primarily focused on concerns about rocket debris and concerns regarding where an errant rocket would land in the event of a mishap. Noise related effects to human health and safety are discussed in Section 3.2.

3.11.1 No Action Alternative

Under the no action alternative, no RRPR test firing would occur at JBLM, and therefore no potential for impacts to human health and safety would occur from RRPR test firing.

3.11.2 Proposed Action – RRPR Noise Assessment Test Launch

Risks to human health and safety associated with rocket firing include risks associated with rocket debris and/or the potential for a rocket to misfire or malfunction and land outside of its intended target area. Firing rockets results in a danger area around the launcher and a surface danger zone safety fan encompassing the corresponding flight corridor extending back toward the launcher. The impact area is designed to contain debris from normally functioning rounds. Since access to this area is restricted, there is no safety risks associated with debris falling into this area.

The safety fan also includes an Exclusion Area, which is the area of the flight corridor within a specified distance of the downrange edge of the firing area. This area would contain rockets if a fuse failed to function. The probability of a rocket or its fragments landing outside the surface danger line has been calculated at 1 in 1,000,000 (Army 1986). The launcher danger area, located

immediately to the rear of the launcher, is the area directly exposed to the launch blast and debris. The entire surface danger zone would be clear of all personnel to avoid accidental injuries from occurring. Because of this assessment the potential impacts to human health and safety are considered negligible, and are considered a less than significant impact associated the RRPR test launch for the proposed noise assessment.

3.12 Cultural Resources

3.12.1 Regulatory Context

Potential impacts to cultural and historic resources are assessed with reference to Section 106 of the National Historic Preservation Act regarding the protection of historic properties (36 CFR 800). Historic properties are buildings, structures, objects, sites, and districts that are listed in or eligible for listing in the NRHP. Historic properties also can be traditional cultural properties (TCPs), which are defined as natural or cultural places that are important to the ongoing traditions or practices of a Native American Tribe or community (Parker and King 1998). The key focus of the Section 106 review process involves determining whether a federal undertaking has the potential to adversely affect a historic property. An adverse effect occurs when characteristics that qualify the property for inclusion in the NRHP are significantly altered. Such alterations are measured by the degree of loss of one or more aspects of integrity, including location, design, setting, workmanship, feeling, and association (36 CFR 60.4). Direct adverse effects can be defined as physical destruction, removal, or alteration of a property or a portion of a property resulting in loss of integrity of location, design, workmanship, and/or materials. Indirect adverse effects include changes to the property's environment that diminish or are inconsistent with its setting, feeling and/or association with its historic context.

Section 106 regulations (36 CFR 800 [2c]) requires the Army to consult with interested Tribes both on an informal and formal, government-to-government level in order to identify cultural, archaeological, natural resources significant to the Tribes as well as traditional cultural places.

3.12.2 Prehistoric and Historic Background

The area where present-day JBLM is located was traditionally occupied by the Nisqually people, who utilized the Nisqually River drainage from Mount Rainier to its mouth, just west of JBLM. At the confluence of streams, the Nisqually built permanent villages, and during the summer they moved between different environmental zones to obtain various food resources (Kreutzer et al. 1994). JBLM was also used by the Puyallup and Steilacoom people, who fished in Chambers, Steilacoom, and Sequalitchew creeks and used open prairies for gathering plants (Dugas and Larson 1998). The Squaxin Island people utilized marine resources of south Puget Sound and the watersheds west of JBLM.

In 1832, the Hudson's Bay Company, an English fur-trading enterprise, established Fort Nisqually west of current-day JBLM. As fur trading became less lucrative, the Hudson's Bay Company established farming stations where many retired fur trappers settled. By the late 1840s, what is now southwestern Washington supported numerous English, Canadian, and Anglo-Indian farming operations (Kreutzer et al. 1994).

In 1917, Camp Lewis was established as one of 16 temporary cantonments built during World War I (Army 1997). More than two-thirds of the Nisqually Indian Reservation was condemned and included in the donation to the War Department. In 1927, the post was renamed Fort Lewis, and in the 1940s it increased in size. In 2010, Fort Lewis and McChord Airforce Base jointed and became Joint Base Lewis-McChord.

3.12.3 Cultural Resource Investigations

In the mid-1970s, JBLM began conducted cultural resource surveys to inventory archaeological sites, historic structures, and traditional cultural properties on the installation. Planning-level archaeological surveys are complete for most of the installation, with an emphasis on the training areas. Approximately 74 percent of the total acreage available for survey (which excludes dudded impact areas) has been subjected to some level of on-the-ground survey. Some of these earlier archaeological surveys do not meet current standards for the identification of historic properties. Very few areas have been subjected to the sort of systematic subsurface investigations necessary to identify prehistoric Native American archaeological sites. Additional archaeological surveys are required to address these unsurveyed or inadequately surveyed areas (excepting in dudded areas where UXO is present), especially in advance of ground-disturbing activities.

Archaeological surveys on JBLM have recorded 378 archaeological sites, of which 20 are prehistoric, 331 are historic, and 27 sites have both historic and prehistoric components. Thirty-seven archaeological sites have been determined eligible for the National Register of Historic Places, 136 have been determined ineligible (including 13 sites classified as cemeteries or monuments to which the National Register criteria are not normally applied), and 205 have not been evaluated for National Register eligibility.

3.12.4 Historic Buildings, Structures, Objects, and Landscapes

The majority of the buildings, structures, and objects built before 1948 have been formally evaluated for National Register eligibility in consultation with the Washington SHPO. JBLM contains three National Register Historic Districts (Fort Lewis Garrison Historic District, Old Madigan General Hospital Historic District, and the American Lake Veteran's Administration Hospital Historic District); one individually listed National Register property (the Red Shield Inn); two individual National Register eligible structures (the Liberty Gate and the Mount Rainier Ordnance Depot Gate); and one individual commemorative property listed on the Washington Heritage Register (the Captain Wilkes July 4, 1841 Celebration Site).

JBLM buildings, structures, and objects constructed after 1948 are either being evaluated or are scheduled for evaluation. Those that are, or soon will be, at least 50 years of age must be considered potentially eligible for listing in the National Register and afforded consideration in accordance with Section 106 of the National Historic Preservation Act.

3.12.5 Traditional Cultural Properties and Uses

On JBLM, the Nisqually, Puyallup, Squaxin Island, and Steilacoom tribes have an interest in traditional cultural properties of religious or other cultural importance, as well as in lands on which

to hunt, fish, and gather. Native Americans conducted hunting, fishing, and gathering activities near their settlements, but also traveled into the prairies and forest uplands to gather plant, animal, and stone resources, which they processed at special-purpose sites such as lithic reduction stations. The use of these areas for fishing, hunting, and gathering was reserved under the Treaty of Medicine Creek, signed in 1854. Continued access and healthy, sustainable resources are especially important for Nisqually tribal members who regularly conduct hunting and fishing activities on JBLM. JBLM has established a clear access policy that recognizes Native American treaty-reserved rights to usual and accustomed places.

3.12.6 No Action Alternative

Under the No Action alternative, training activities by the battalions would continue to have the potential to affect cultural resources by disturbing the ground, and by potentially restricting tribal access to sites of cultural significance on JBLM. Vehicle travel by battalion vehicles would continue to be almost entirely on existing roads and trails. Minimal digging by the battalions would continue to occur, primarily individual fighting positions associated with battery and battalion level training exercises. Archaeological resources on JBLM would continue to be protected from ground-disturbing activities by a permit process that requires a cultural resources review of an area before digging can begin. Potential incidents of vandalism by soldiers would continue to be minimized through soldier awareness training.

Training activities by the battalions could continue to potentially result in conflicts between training needs and desired tribal access to JBLM training lands for traditional uses. However, any restrictions to site access would continue to be temporary, lasting only as long as the training activity. Continued coordination with the tribes and advanced scheduling would help to limit the degree of conflict.

3.12.7 Proposed Action – RRPR Noise Assessment Test Launch

For the proposed noise assessment, the RRPR test launch may affect some portion of lands located on the Nisqually Indian Reservation, as well as lands on JBLM that are of traditional cultural and/or religious significance to Indian tribes. These lands may contain natural resources associated with rituals or celebrations, or include places that are important in the ongoing traditional or spiritual practices of the Nisqually Indian Tribe, Puyallup Tribe, Squaxin Island Tribe, and Yakama Indian Nation. Section 106 regulations require a federal agency to consult with tribes on whose lands an undertaking will occur (36 CFR 800.3[d]). For the 2008 proposed long-term HIMARS training project, the Army initiated consultation with the tribes in September 2008 with Section 106 letters (in Appendix B), and continued consultation through the public scoping process. In response to a request, the Army met with the Nisqually Indian Tribe in September 2008 to further discuss the proposed training. In a letter dated October 20, 2008, the Nisqually Indian Tribe expressed concerns about potential effects of the Proposed Action on fish and animal resources, and on members of the tribe and the larger community. Members of the Yakama Nation and Nisqually Indian Tribe also observed HIMARS rocket launches at YTC in February 2009. The Army has continued to coordinate with the Nisqually Indian Tribe. The Army has presented the proposed action with the Tribe in May 2015.

The Army completed Section 106 consultation with the Washington State Historic Preservation Officer (SHPO), and evaluated likely impacts to buildings, structures, and objects that are eligible for the National Register of Historic Places in 2008 as a result of long-term HIMARS training (Appendix B). For the proposed noise assessment, the Army will re-initiate consultation with SHPO.

An archaeological investigation for proposed tree removal for the 2008 long term HIMARS training at Hayes Hill firing point was conducted in January 2008 to identify resources that could have been impacted by ground disturbance within the area to be cleared for trajectory clearance. This firing point has been in use since 1920 for military training and has been periodically cleared of vegetation (in 1965, 1980, 1994, and 2004). The study included background research to determine the extent of previous archaeological surveys and the location of known archaeological resources. The previous investigations, along with a search of the archaeological records databases maintained by JBLM, indicated that no archaeological resources are located in the area to be cleared. The report was filed with the Washington SHPO as a finding of "No Historic Properties Affected" in partial fulfillment of Section 106 compliance for the 2008 long-term HIMARS training. The SHPO concurred with the finding of no effects in September 2008.

Noise associated with rocket firing would have the potential to affect historic buildings and culturally-significant resources, and could potentially limit access to sacred sites on JBLM, if present.

Certain historic buildings are more sensitive to acoustic vibrations than newer buildings and structures because materials such as masonry and windows have fatigued over time due to weathering and other environmental stresses. Studies of sonic booms and other loud, impulsive noises suggest that age and building materials are significant factors in whether a building can be damaged from noise (e.g., Clarkson and Mayes 1972, Batis 1983). As discussed in Section 3.2.2, noise contours have been modeled for the proposed RRPR test launch (Figure 3-3). The Army (2014) has determined that concern by homeowners about structural rattling and the potential for building damage occurs at peak decibel levels of greater than 120 dB, but actual damage is not likely to occur at decibel levels lower than 150 dB.

Based on a search of the JBLM historic buildings database and the Washington Department of Archaeology and Historic Preservation historic property inventory database, just one NRHP-listed historic property is located near the 130-dBP rocket noise contour. This site is the Nisqually School**,** a one-story, two-room wood frame structure built in 1911 in rural Thurston County. The structure was recorded in 1989 and evaluated as eligible for the NRHP and the Washington Heritage Register for its association with one of the oldest school districts in Washington (Stevenson 1989). This structure is located outside of the 130-dBP noise contour line, and therefore would not be exposed to noise levels of 140 dBP or greater; the threshold level for potential structural damage, Therefore, this property should not be impacted by RRPR test launch for the noise assessment.

The RRPR test launch could limit access to areas around Hayes Hill firing point for 3-days, which could adversely affect tribal members, particularly if sacred or other culturally important sites are

present in the area. These effects would be short-term in duration, lasting only for 3 days one time, and would be minimized by advance notice and coordination with the tribes.

3.13 Aesthetic and Visual Resources

The visual environment on JBLM consists of both natural and man-made features. The largest man-made environment on the installation is the cantonment area, which includes administrative, residential, commercial, warehouse, and maintenance buildings; a small airfield; recreational facilities; and open space for military activities. The structures in the cantonment area vary in age and construction, with some World War I buildings, some World War II wood-frame buildings, historically significant brick buildings, and many buildings of indistinct construction.

The principal viewer groups at JBLM include on-site personnel, visitors, installation neighbors, and travelers on nearby roads. From within the installation, views include the cantonment area, roads, and other infrastructure, as well as Mount Rainier and various other natural features. The extensive wooded areas and flat terrain of the installation prevent the majority of views out of and onto JBLM. A notable exception is the I-5 corridor, which passes through the cantonment area, and provides views of the developed portion of the installation to passing motorists.

3.13.1 No Action Alternative

Under the No Action alternative, effects to visual resources would not occur. Training activities by the battalions could continue to affect the visual environment for short periods of time, primarily through the presence of vehicles and equipment in the natural settings of JBLM training lands. Recreational users, which are considered a sensitive viewer group, could continue to observe some of these visual alterations, depending on their location. Alterations to the visual environment would not be new, since training lands are already regularly used for similar activities, and recreational users and other visitors to JBLM would expect to see Army vehicles and equipment when on the installation.

3.13.2 Proposed Action – RRPR Noise Assessment Test Launch

Clearing of one acre of forested training land near the Hayes Hill firing point would not significantly alter the visual characteristics of the area. The only visual groups likely to be affected would be military personnel accessing the firing point area for training. Because the area to be cleared would continue to be surrounded by forest on all sides, the alteration would not be visible from a distance, except from above. Given the relatively level topography in the area, it is not expected that the affected area would be visible to off-site viewers from the ground level. Additionally, the site is immediately adjacent to the Hayes Hill firing point, which has already been cleared and continues to be maintained in an open condition. Therefore, high quality or distinctive views, including scenic vistas, would not be affected by changes to the cleared area. Effects to visual resources would minor.

Launching of RRPRs for the noise test would create short-term visual impacts at the firing point, along the rocket trajectory, and in the airspace immediately surrounding it. During each rocket launch, visual impacts would include a smoke and dust cloud at the firing point, the glowing shape

of the rocket in flight, and a white, smoke-like trail marking the path of the rocket. The bright yellow glow of the rocket would last only for a few seconds, until the propellant is used up. The smoke/dust cloud at the launch site and the trail along the rocket's path would last longer, slowly dissipating and becoming less distinct. Because of the topography in the area, the visual impacts associated with RRPR launches would not be visible from a great distance away from the launch site, or from nearby communities such as DuPont. However commuters travelling north on I-5 (vicinity of exit 114), as well as residents in the nearby Nisqually valley would likely see the RRPR's smoke-like trail after the launch, which may create a visual distraction. If visible from these areas, the visual impact would be of extremely short duration. Given the infrequency and short-term nature of these visual effects, they would be considered minor.

3.14 Recreation

Certain portions of JBLM are available to military personnel and the public for outdoor recreation. There are over 20 outdoor recreation areas on JBLM, which include parks, picnic areas, and rental facilities. Common activities that take place on the installation are hunting, fishing, camping, biking, hiking/jogging, swimming/scuba diving, boating, and wildlife viewing. Some of the outdoor recreation activities occur in the training areas. These activities require coordination with Range Division to ensure the safety of recreational users, and to prevent conflicts with military training needs.

For the most part, all training areas on JBLM are open to hunting, with the exception of a few off-limits areas. With the exception of Nisqually Lake, Department of Defense personnel and their family members may fish all the lakes and streams on JBLM unless otherwise posted or unless they are closed by a Daily Bulletin announcement. The general public may fish and/or boat only on American Lake, Chambers Lake, and the Nisqually River.

JBLM has a variety of indoor recreation facilities, including indoor swimming pools, a bowling center, a roller skating rink, indoor gymnasiums and courts, recreation centers, shooting ranges, a theater, a military museum, and three libraries. The majority of these facilities are located in the main cantonment area.

Off-post recreation is available in areas adjacent to the installation, including various parks and golf courses in the neighboring communities, and on the Nisqually River, Puget Sound, and American Lake. The Nisqually National Wildlife Refuge, located northwest of JBLM, is a notable location for bird watching. Additionally, there is a campground located on the Nisqually River, just west of the installation.

3.14.1 No Action Alternative

Under this alternative, training activities by the battalions would continue to restrict recreation in certain training areas for varying amounts of time, depending on the type of activity. These restrictions would temporarily affect certain types of outdoor recreation, much of which could be relocated to another area on the installation, or be rescheduled for a different time. Restrictions on availability of training lands for recreation would continue to be greatest at shooting ranges (available to Department of Defense personnel and their families), and in prairie habitats, which are commonly used for horseback riding and bird watching. Many popular areas for recreation

(e.g., Northwest Adventure Center, American Lake, and other marshes and lakes) would not be in conflict with restrictions caused by battalion training.

3.14.2 Proposed Action – RRPR Noise Assessment Test Launch

Harvesting trees from approximately one forested acre on JBLM could potentially impact recreation by reducing the amount of forested habitat available for outdoor recreational activities (such as hunting forest-dwelling game species). These effects would be negligible, since the cleared area represents a fraction of a percent of the total forested area (approximately 50,000 acres) on the installation, and forested habitat is available elsewhere for outdoor recreation. Additionally, the area around the Hayes Hill firing point is not used for recreation on a regular basis, has no established facilities, and is not near any established recreational sites.

During the 3-day noise assessment, RRPR test firing would cause loud noise levels that could potentially disturb recreation on post, as well as in nearby off-post areas, such as the Nisqually National Wildlife Refuge, parks, golf courses, and other popular recreation sites. Launching of rockets would create a loud jet-like sound, followed by a sonic boom that sounds similar to thunder (refer to Section 3.2.2 for more details on noise effects). The intensity of noise experienced by people recreating would depend on their location in relation to the firing point and the direction of rocket launch, weather conditions, and topography. Visual intrusions would potentially include a view of the glowing yellow rocket as well as its vapor trail and a smoke/dust cloud. However, these sights would not be readily observable from off-post, given the relatively level topography in the area. In the case of certain types of recreation, such as hunting and fishing, horseback riding and wildlife viewing, noise from rockets could further reduce the quality of experiences by startling animals. These effects to recreation would be minimal since the proposed noise assessment would only occur over 3-days and would not preclude or eliminate recreational opportunities.

Additionally, 3-days of RRPR test firing for the noise assessment could limit recreation on JBLM in the vicinity of the Hayes Hill firing point during that 3-day time period. These effects would be minor, given that the area is not used for recreation on a regular basis, no established recreational sites are in the area, and the activities could be rescheduled or relocated to other areas on the installation.

3.15 Cumulative Effects

The cumulative effects discussion addresses the effects of future Federal, State and/or private activities that are reasonably certain to occur within the action area. The decision to conduct long-term firing of RRPRs at JBLM was not considered an indirect effect, nor a cumulative effect of the proposed action, because conducting the noise assessment does not make reasonably certain that firing of RRPRs will also occur at JBLM in the future. The proposed noise assessment is for obtaining noise data regarding launching of RRPRs at JBLM, and to have a forum for community feedback. If a plan to fire RRPRs for training were initiated in the future, additional NEPA analysis would be required for that action.

Because the proposed action would be a onetime occurrence lasting 3 days with 1 acre of forest cleared, cumulatively the effects to all the resources would overall be minimal. The existing land use would not change. In combination the other noise and air emissions generating activities on JBLM, the proposed noise assessment would only slightly add to the noise and air emissions generating activities during the 3-day RRPR test launch. For all current and future on-base activities that have a fire risk including the proposed action, existing fire management programs would be utilized to minimize the risk from fire, thereby the proposed action cumulatively would not increase the risk of fire. The cumulative effects to soils and water resources would be minimal due to the short duration of the proposed action. The 3-day test launch would occur in winter and would not expose fish and wildlife to greater peak noise levels than they currently experience on and near the installation. Species that use these habitats likely have adapted to noise associated with military activities, and would not be cumulatively impacted by the short-term noise assessment. The proposed 3-day RRPR test launch would be shorter duration and consistent with other on-going activities at JBLM and therefore would only negligibly contribute to effects on cultural resources, aesthetic and visual resources, and recreation.

4.0 CONCLUSIONS

Based on the above analysis, this project is not a major Federal action significantly affecting the quality of the human or natural environment, and therefore does not require preparation of an environmental impact statement. A signed FNSI will complete this environmental review.

5.0 LIST OF PREPARERS

The following people contributed directly to preparation of this document:

- Hannah Hadley, Environmental Coordinator
- Melissa Leslie, Environmental Coordinator
- J. Robert Thomas, Supervisory Biologist

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7.0 APPENDICES

Appendix A: Air Emissions Calculations

criteria pollutant	FY2013 JBLM air emissions	worst case scenario emissions estimate from 2009 project	Total	Limit	Exceedence?
Pb	0	0	0	100	N
PM10	5		5	100	N
SOx	2		2	100	N
NOx	82	0.0003	82.0003	100	N
VOC	43		43	100	N
CO	55	5.2154	60.2154	100	N
HAP	5	14.977	19.977	25	N

Info from 2009 emissions modeling:	
AlCl	0.0027
AlCl2	0.0133
AlCl3	0.0023
Al0Cl	0.002
Al2O3	8.0698
CO2	0.6737
Cl	0.0465
Fe	0.0043
FeCl	0.0008
FeCl2	0.3744
Fe(OH)2	0.476
H	0.0034
HCl	4.8095
H2	0.4934
OH	0.0049

Appendix B: 2008 Section 106 Consultation

STATE OF WASHINGTON

DEPARTMENT OF ARCHAEOLOGY & HISTORIC PRESERVATION

1063 S. Capitol Way, Suite 106 • Olympia, Washington 98501
Mailing address: PO Box 48343 • Olympia, Washington 98504-8343
(360) 586-3065 • Fax Number (360) 586-3067 • Website: www.dahp.wa.gov

September 9, 2008

Dr. Bret Ruby
Installation Management Command
Box 339500, MS 17
Fort Lewis, Washington 98433-9500

Re: Hayes Hill Firing Point Project
Log No: 090908-07-DOA

Dear Dr. Ruby;

Thank you for contacting our department. We have reviewed the materials you provided for the proposed High Mobility Artillery Rocket System and Hayes Hill Firing Point Project at Fort Lewis, Pierce County, Washington.

We concur with your determination of No Historic Properties Affected.

We would appreciate receiving any correspondence or comments from concerned tribes or other parties that you receive as you consult under the requirements of 36CFR800.4(a)(4).

These comments are based on the information available at the time of this review and on behalf of the State Historic Preservation Officer in compliance with the Section 106 of the National Historic Preservation Act, as amended, and its implementing regulations 36CFR800.4. Should additional information become available, our assessment may be revised, including information regarding historic properties that have not yet been identified.

In the event that archaeological or historic materials are discovered during project activities, work in the immediate vicinity must stop, the area secured, and the tribe's cultural committee and this department notified. Thank you for the opportunity to comment and a copy of these comments should be included in subsequent environmental documents.

Sincerely,

Robert G. Whitlam, Ph.D.
State Archaeologist
(360) 586-3080
email: rob.whitlam@dahp.wa.gov

DEPARTMENT OF ARCHAEOLOGY & HISTORIC PRESERVATION
Protect the Past, Shape the Future

DEPARTMENT OF THE ARMY
INSTALLATION MANAGEMENT COMMAND
UNITED STATES ARMY GARRISON, FORT LEWIS
BOX 339500, MAIL STOP 17
FORT LEWIS WASHINGTON 98433-9500

REPLY TO
ATTENTION OF

7 September 2008

Public Works

Dr. Allyson Brooks
State Historic Preservation Officer
Department of Archaeology and Historic Preservation
P.O. Box 48343
Olympia, Washington 98504-8343

Re: Proposed Removal of Trees from the Existing Hayes Hill Firing Point, Training Areas 3 and 4, Fort Lewis, Washington

Dear Dr. Brooks:

The Army is preparing an Environmental Assessment (EA) for the potential operation and use of the High Mobility Artillery Rocket System (HIMARS). As a first step, we are evaluating the potential impacts of clearing trees to allow the use of the Hayes Hill Firing Point for HIMARS. The Area of Potential Effects in the attached assessment is limited to ground disturbances associated with tree removal at Hayes Hill Firing Point. We will continue to consult with you to evaluate potential effects on air, noise and other resource types as the EA process develops.

Dale L. Sadler, the Fort Lewis Archaeologist, has completed an *Assessment of Project Effects* for the clearing of Hayes Hill Firing Point. Sadler has concluded the area to be adequately surveyed and has been subjected to extensive terrain alterations through its long-use as a firing point and previous tree clearing. His assessment is attached.

We have determined that the proposed Hayes Hill Firing Point tree removal at Fort Lewis would result in "no historic properties affected." Please provide comment on our determination in accordance with 36CFR800.5(c). Should you have any questions about the project or desire additional information, please do not hesitate to contact me at (253) 966-1785.

Sincerely,

Bret Ruby, Ph.D.
Installation Cultural Resource Manager
Environmental Division
Fort Lewis, WA

Enclosures

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