PROGRAMMATIC ENVIRONMENTAL ASSESSMENT
FOR THE
PERMANENT HIGH EXPLOSIVE TEST SITE
AND
BEDROCK PENETRATION TEST SITES
WHITE SANDS MISSILE RANGE, NEW MEXICO

Final

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U.S. ARMY WHITE SANDS MISSILE RANGE
NEW MEXICO
FINDING OF NO SIGNIFICANT IMPACT

NAME OF PROPOSED ACTION: Programmatic Environmental Assessment for the Permanent High Explosive Test Site and Bedrock Penetration Test Sites, White Sands Missile Range, New Mexico.

DESCRIPTION OF PROPOSED ACTION: This is a programmatic environmental assessment (PEA) for the Permanent High Explosive Test Site (PHETS), the Seismic Hardrock In Situ Test (SHIST), and Alternative SHIST (Alt. SHIST) Sites at White Sands Missile Range (WSMR). This PEA is designed to add flexibility to current test parameters covered by existing National Environmental Policy Act (NEPA) documentation and to serve as an environmental reference for future planning and development.

The Defense Threat Reduction Agency (DTRA) proposes to continue testing at PHETS, SHIST, and Alt. SHIST to evaluate the effectiveness of various weapon and delivery systems to defeat hardened military targets. Four types of testing are evaluated: 1) static high explosive tests, 2) warhead penetration tests, 3) collateral damage assessments using approved chemical and biological weapon simulants, and 4) counter terrorism tests. All four types of tests will take place at PHETS; testing at SHIST and Alt. SHIST will be limited to penetration testing and static high explosive testing using charges of 454 kilograms (1,000 pounds) or less. Other proposed actions include expansion of the construction landfill at PHETS by an additional 9 hectares (22 acres) and the SHIST Site by an additional 14 hectares (35 acres).

PURPOSE AND NEED OF PROPOSED ACTION: The purpose of the proposed action is to provide for continued testing at PHETS, SHIST, and Alt. SHIST at current or slightly increased levels.

Vulnerability and survival characteristics of military assets and the effectiveness of weapons employed to defeat them is crucial information in support of the military mission. Systems designed to defeat military assets must be continuously developed and evaluated to counter improvements in enemy systems. U.S. and allied military structures and equipment, alternately, must be refined to better withstand attack by enemy weapon systems. Weapons of mass destruction, such as chemical and biological agents manufactured by unfriendly forces in hardened, reinforced structures, are a significant threat to international stability and peaceful coexistence. Upon defeat of these targets, the release of chemical and biological agents poses a risk to innocent, non-military populations. Greater understanding of dispersal characteristics of these agents is needed to minimize civilian casualties.

ALTERNATIVES CONSIDERED: Four alternatives to the proposed action were considered, including changing the scope of the proposed action, conducting the testing at a facility other than WSMR, conducting the testing at sites on WSMR other than PHETS, SHIST, and Alt. SHIST, and No Action. Changing the scope of the proposed action was considered, but was not a viable option. The option to conduct these actions at a facility other than WSMR is viable. The requirements and parameters of individual tests will be evaluated to determine which facility is most suitable; however, on a programmatic level, WSMR has the most competitive combination of infrastructure, land area, and air space needed to conduct the various types of testing activities. Alternate test sites within WSMR were also evaluated. PHETS, SHIST, and Alt. SHIST sites have the necessary physical characteristics and infrastructure to support the proposed test activities and are previously disturbed areas. While other areas of WSMR would be suitable from a testing perspective, it would not be cost effective or environmentally responsible to duplicate existing facilities elsewhere on WSMR. Pursuing No Action would allow facility operation and testing activities to continue as approved in previous NEPA documentation, but would not allow the flexibility to address emerging threats to the U.S. and its allies.

ENVIRONMENTAL CONSEQUENCES:
A total of ten broad environmental issues were evaluated to determine the potential effects of the proposed actions and to provide a basis for assessing their significance.

The physical resources impacted by testing and construction activities include location and topography, aesthetics, soils, and water resources. Topography, aesthetics, and soils will be affected at all three sites by cratering and/or construction activities. Soil and water resources may also be affected by static high explosive and collateral damage assessments taking place at PHETS. Disturbances will be mitigated by returning the landscape to its approximate original contours and by using appropriate erosion control measures as soon as possible following tests. A monitoring program will be set up to detect changes in soil, vegetation, and ground water that would indicate test-related impacts.

There are no threatened, endangered, or sensitive species of flora or fauna found in the PHETS, SHIST, or Alt. SHIST areas; however, there is suitable habitat at one or more sites for several Federal- or State-listed faunal species including the aplomado falcon (*Falco femoralis septentrionalis*). No threatened, endangered, or sensitive species were found during biological surveys of the sites. Furthermore, the habitats involved are common throughout the Jornada del Muerto and Tularosa basins. These habitats, including the grasslands favored by the aplomado falcon, will be affected but not adversely impacted by the proposed action. The use of simulants and other test materials at PHETS necessitates additional monitoring of vegetation, insects, and other fauna to determine whether test materials are building up in the environment. If accumulation is occurring, one or more chemicals will be eliminated from use in test activities.

Test activities will be designed to avoid all designated archaeological sites, and appropriate mitigation measures will be taken to avoid any significant or cumulative damage to McDonald Ranch House, a Trinity National Historic Landmark structure. Actions will only occur in areas that have been surveyed for cultural resources, and any resources found will be evaluated according to Section 106 and in consultation with the State Historic Preservation Office.

There will be transitory effects on air quality at all three sites from sporadic dust generated by test activities, plus construction, simulant plumes, and use of the concrete batch plant at PHETS. Other emission sources include vehicles, equipment, and generators. Transitory noise sources will include aircraft, blast, and equipment. Numerous Federal, State, and Army regulations will address the handling of hazardous waste as well as health and human safety issues. There will no be significant sources of radiation present at any of the sites. The socioeconomics and infrastructure of WSMR and surrounding population centers will not be significantly affected by the proposed action.

CONCLUSIONS: The proposed construction and testing activities evaluated in this PEA will not significantly affect environmental quality at the PHETS, SHIST, or Alt. SHIST. Necessary mitigation measures will be implemented to reduce or eliminate potential impacts associated with the proposed actions. All Federal, State, and local laws and regulations will be followed. An Environmental Impact Statement is not required. This Finding of No Significant Impact is hereby submitted for the proposed action.

POINT OF CONTACT: An environmental document that supports this Finding of No Significant Impact is available for public reading at the following locations: the WSMR Environment and Safety Directorate, Building 163, WSMR; WSMR Public Affairs Office, Building 1782, WSMR; and public libraries in Las Cruces, Alamogordo, and Socorro, New Mexico. All are invited to submit written comments for consideration by the Commander, WSMR, within 30 days of the notice. Address all correspondence to:

Department of the Army
U.S. Army White Sands Missile Range
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Date

WILLIAM F. ENGEL
Brigadier General, USA
Commanding

EXECUTIVE SUMMARY

This is a Programmatic Environmental Assessment (*PEA*) for the Permanent High Explosive Test Site (PHETS), and the Seismic Hardrock In Situ Test (SHIST) and Alternative SHIST (Alt. SHIST) sites at White Sands Missile Range (WSMR). This *PEA* is designed to add flexibility to current test parameters covered by existing National Environmental Policy Act (NEPA) documentation and to serve as an environmental reference for future planning and development of the Anti-Terrorism, Counter Proliferation, and other foreseeable programs. Specifically, this document not only evaluates environmental effects for new proposed actions, but also reevaluates environmental effects of proposed testing considered in existing NEPA documents in order to extend the length of the entire test program. Coordinating and reviewing agencies are listed in Appendix H in the Distribution List.

The Defense Threat Reduction Agency (DTRA) proposes to continue testing at PHETS, SHIST, and Alt. SHIST in order to evaluate the effectiveness of various weapons systems to defeat military targets. Four types of testing employing a number of weapons are proposed, including static explosive tests, warhead penetration tests, collateral damage assessments, and counter terrorism tests.

Static high explosive and conventional explosive testing is proposed at PHETS for assessment of damage resistance to mobile and fixed targets such as military structures and equipment. Environmental effects and mitigations of explosive testing for previous tests are summarized in the *Environmental Assessment of Long-Term High Explosive Testing at White Sands Missile Range Permanent High Explosive Test Site* (1987).

Warhead penetration testing using live and inert, air-delivered and ground-borne munitions is proposed at all three sites in order to assess the ability of weapons to defeat both hard and soft targets. The construction of an underground parking facility is proposed as an additional target at PHETS. Expansion of the SHIST Site is proposed to accommodate further testing in granite. Environmental impacts and mitigations related to penetration-type testing are summarized for previous tests in the *Addendum to the Environmental Assessment of Long-Term High Explosive Testing at Permanent High Explosive Test Site White Sands Missile Range* (1995), the *Environmental Assessment for Seismic Hardrock In Situ Source Test* (1993), the *Environmental Assessment for Missile Technology Demonstration Program* (1995) and the *Dipole Samson Environmental Assessment* (1997).

Tests employing chemical and biological simulants and taggants are proposed at PHETS in order to examine the behavior of plumes containing chemical or biological agents after defeat of enemy chemical and biological warfare production facilities. Simulant plumes will be generated by explosive or mechanical means. Simulants, placed either in hardened structures or in the open, may be targeted with air-delivered munitions or detonated with statically-placed munitions or explosives. Taggants within the plume would allow laser tracking of the plume and samples taken from the plume would be used to assess concentration of chemical and biological simulants at various distances from the impact site. Environmental effects and mitigations involving taggants, biological simulants, and triethylphosphate, a chemical simulant, are summarized for previous tests in the *Supplement to the Long-Term High Explosive Testing at White Sands Missile Range Permanent High Explosive Test Site* (1995), and the *Second Supplement to the Long-Term High Explosive Testing Environmental Assessment at White Sands Missile Range Permanent High Explosive Test Site* (1998).

Counter terrorism tests are proposed at PHETS in order to enhance survivability of personnel and property in the event of terrorist attack. These tests will involve small-scale explosions contained in or near an existing four-story test structure.

Expansion of the landfill at PHETS is proposed in order to accommodate disposal of test-related construction materials.

Four alternatives to the proposed action are considered, including changing the scope of the proposed action, conducting the testing at a facility other than WSMR, conducting the testing at sites on WSMR other than PHETS, SHIST and Alt. SHIST, and No Action. Because similar testing has been ongoing at PHETS, SHIST and Alt. SHIST, the infrastructure is in place to accommodate the proposed action. In addition, environmental impact at these sites is low relative to other WSMR sites and other military facilities. The No Action alternative has limited value because it would not allow the flexibility to address emerging threats to the United States and its allies.

There are two types of activities described by the proposed action that will impact the local environment. First, test preparation and recovery activities such as expansion of SHIST Site and construction of roads, target structures, a three-story underground parking garage, expansion of the landfill, upgrading the PHETS administrative park, plume sampling and ordnance recovery have the potential to affect cultural and biological resources at PHETS, SHIST and Alt. SHIST sites. Mitigation would be conducted in order to minimize impact. Preventative measures would be taken to protect the McDonald Ranch House, and test activities will be designed to avoid all designated archaeological sites. Existing roads would be used whenever possible to limit damage to surrounding soils, flora, fauna and cultural resources. New roads would be evaluated and approved by the White Sands Environmental Services office (WS-ES) prior to road development. Erosion control measures will be implemented where needed during site expansion, construction, and recovery activities. Raptor protection devices will be placed on all new electric poles. Escape ramps will be placed in and fencing will be placed around depressions and craters to allow egress of small animals and prevention of large animals from entering these areas. At the end of use, test structures will be demolished and explosion craters filled in and allowed to return to a natural state or re-seeded with native vegetation if needed.

The second proposed action with the potential to impact the environment is testing involving chemical and biological simulants. To ensure that these simulants are having no effect on the environment a monitoring plan will be implemented. Samples will be taken of groundwater from three monitoring wells in the area and soils will be sampled near test structures. Plots previously placed in the PHETS area, as well as additional plots that will be emplaced, will be monitored for changes in the animal and plant community. Specific insect taxa in the area will be monitored for any affects. Control plots will be established near PHETS (but outside of areas affected by PHETS testing) in communities with similar soil and vegetation type. These plots will provide baseline data to compare to testing area data. An annual report of sampling results will be provided to WS-ES.

The aplomado falcon is the only federally protected species potentially affected by the proposed testing. Although the species has not been sighted at PHETS in recent years, this area contains suitable habitat for the species. Any sighting of this species will be reported to WS-ES. Potential habitat for the aplomado falcon will be affected but not adversely impacted by the proposed activities. No protected species are known to inhabit the SHIST and Alt. SHIST areas.

With test activities contained in small areas relative to the surrounding environment and adoption of appropriate mitigation measures as described in this document, there will be no significant impact to the environment from the proposed action.

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1.0 INTRODUCTION

1.1 OVERVIEW

The Defense Threat Reduction Agency (DTRA) is a tenant organization that operates and manages several test sites in the northern part of White Sands Missile Range (WSMR), New Mexico (Memorandum of Agreement between WSMR and Field Command, Defense Special Weapons Agency [FCDSWA], 1997; Support Agreement between WSMR and FCDSWA, 1998). These sites include the Permanent High Explosive Test Site (PHETS), Seismic Hardrock In Situ Test (SHIST) Site, and Alternate SHIST Site (Alt. SHIST) (Figure 1).

PHETS mostly lies within the boundaries of Trinity National Historic Landmark and has been used for high explosive events and tests to evaluate the effectiveness of various weapon systems to defeat hardened targets. The term "hardened targets" refers to military structures, typically buried or built into bedrock mountainsides, which are protected further by thick layers of concrete and/or compacted soil. Collateral damage resulting from the release of chemical and biological agents after target defeat is evaluated at PHETS using simulants (non-symptomatic materials which simulate the dispersion characteristics of chemical and biological weapons agents) and taggants (materials used to track the path of simulant plumes through the air). SHIST, situated on the western slopes of the Oscura Mountains, and Alt. SHIST, located approximately 2.4 km north of Capitol Peak in the San Andres Mountains, are used principally for bedrock penetration tests of various warheads.

It has been determined that a Programmatic Environmental Assessment (*PEA*) for PHETS, SHIST, and Alt. SHIST is needed to address future testing activities and to add flexibility to current test parameters covered by existing National Environmental Policy Act (NEPA) documents. The *PEA* will include a review of current operations, and serve as an environmental reference for future planning and development of Anti-Terrorism, Counter Proliferation, and other foreseeable programs.

1.2 PREVIOUS NEPA DOCUMENTATION

The region presently encompassed by PHETS was used for large ammonium nitrate-fuel oil (ANFO) explosive tests beginning in the 1970s and environmental assessments for these tests were produced (e.g., DICE THROW, MILL RACE, MINOR SCALE, and MISTY PICTURE). In 1987, program activities at PHETS were evaluated under the *Environmental Assessment of Long-Term High Explosive Testing at White Sands Missile Range: Permanent High Explosive Test Site* (herein, the PHETS EA of 1987). Testing at PHETS progressed to include the use of air-delivered munitions and ground-based projectile guns. The NEPA document evaluating this type of testing is *Addendum to the Environmental Assessment of Long Term High Explosive Testing at WSMR PHETS* (July 1995).

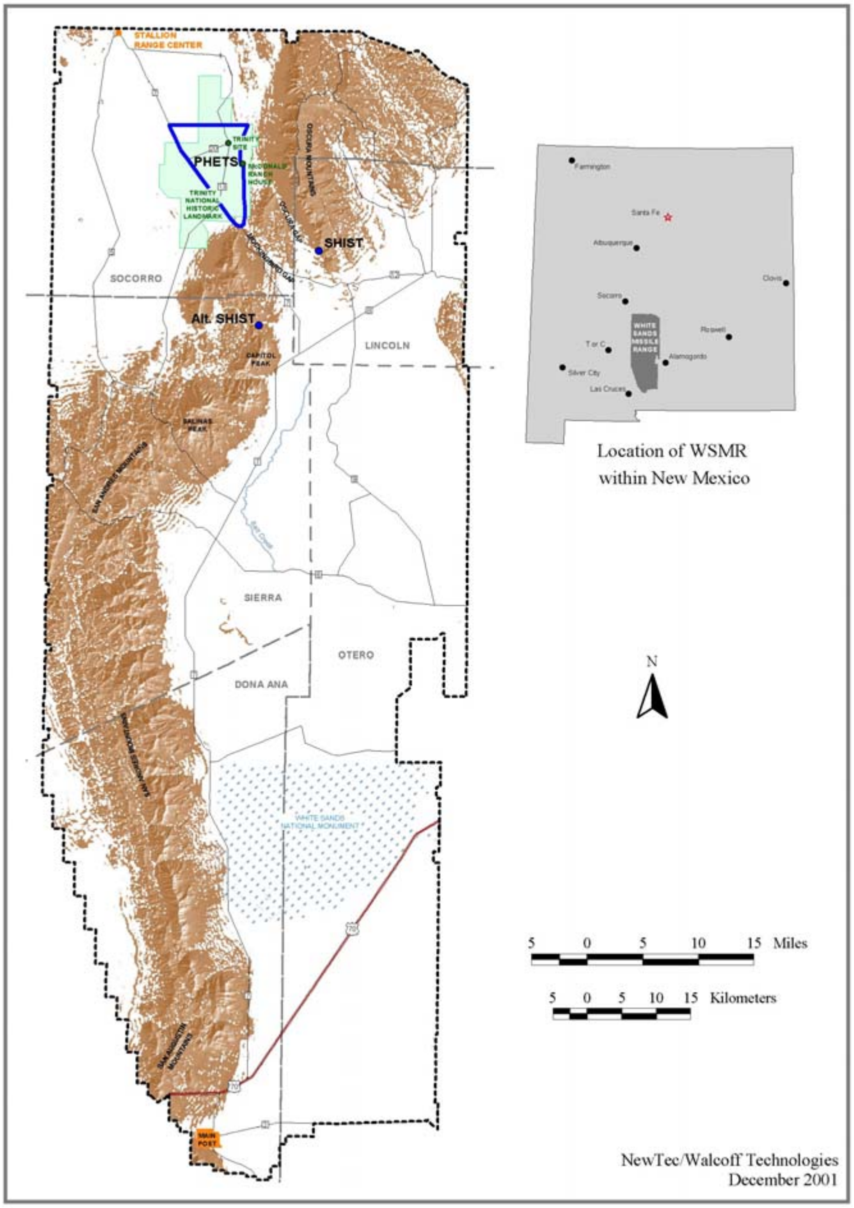

Figure 1. Project locations within White Sands Missile Range.

During the development and use of PHETS, the Defense Nuclear Agency (DTRA's predecessor) began conducting tests at SHIST and Alt. SHIST. In 1993 SHIST was analyzed for environmental effects related to a high explosive test simulating an underground nuclear blast in *Environmental Assessment for Seismic Hardrock In Situ Test* (SHIST). The use of Alt. SHIST began in 1995 with missile impacts evaluated in *Environmental Assessment for Missile Technology Demonstration Program*. Two years later the testing at Alt. SHIST expanded to incorporate the use of air-delivered inert warheads, the Davis Gun, and air gun tests. Environmental effects from these types of tests were evaluated in the *Dipole Samson Environmental Assessment* (1997).

Testing at PHETS expanded to test collateral effects. Chemical and biological simulants and taggants, substances used for airborne plume generation and tracking, were addressed in the *Supplement to the Long-Term High Explosive Testing Environmental Assessment for Collateral Effects Test Series* (October 1995). The use of larger quantities of simulants and additional taggants was covered in the *Second Supplement to the Long-Term High Explosive Testing Environmental Assessment,* dated April 1998 and evaluated the use of the chemical simulant triethyl phosphate (TEP) in large quantities and its environmental fate and effects.

Numerous environmental documents (mostly U.S. Army Records of Environmental Consideration [RECs]) have been written for specific tests at the PHETS, SHIST, and Alt. SHIST sites. These tests are listed chronologically in Appendix A.

1.3 PURPOSE AND NEED

The purpose of the proposed action is to establish adequate areas, testbeds and facilities for performing high explosive and biological and chemical collateral damage assessments. Vulnerability and survival characteristics of military assets and the effectiveness of weapons employed to defeat these assets is crucial information in support of the military mission. Systems designed to defeat military assets must be continuously developed and evaluated to counter improvements in enemy systems. United States and allied military structures and equipment, alternately, must be refined to better withstand attack by enemy weapon systems.

Weapons of mass destruction, such as chemical and biological agents manufactured by unfriendly forces in hardened, reinforced structures, are a significant threat to international stability and peaceful coexistence. Upon defeat of these targets, the release of chemical and biological agents poses a risk to innocent, non-military populations. Greater understanding of dispersal characteristics of these agents is needed to minimize civilian casualties.

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2.0 PROPOSED ACTION

On-going testing as previously described is proposed to continue at PHETS, SHIST, and Alt. SHIST. Collateral damage resulting from the release of chemical and biological (chem/bio) agents after target defeat will be evaluated through the use of new types of simulants and taggants. Other proposed actions will include new construction, expansion of the PHETS landfill, and boundary expansion at SHIST. If implemented, these actions will ensure a more accurate assessment of the most up-to-date weapon systems to defeat hardened targets.

2.1 ON-GOING TESTING ACTIVITIES

The major testing activities at PHETS, SHIST, and Alt. SHIST that have occurred through time are proposed to continue into the foreseeable future. The evolution of programs conducted at these test sites can be generalized as a progression from large static detonations to warhead penetration of hardened targets and simulant-based collateral damage assessments. Four broad-based categories of testing activities have been identified as follows: static high explosive tests, warhead penetration tests (live and inert), collateral damage assessments using chemical and biological simulants, and counter-terrorism tests.

The following sections summarize the activities that have taken place at PHETS, SHIST, and Alt. SHIST. These activities are proposed to continue as appropriate program types for an indefinite period of time. (Refer to Appendix A for a summary of specific test information).

2.1.1 Static High Explosive Tests

Spanning most of its history as a test facility, PHETS has been used for high explosive (HE) testing of static charges (ground-level and below-ground). These tests have been conducted to measure the survivability of military assets against effects of simulated nuclear blasts, and to calibrate equipment for determining compliance with the Threshold Test Ban Treaty. High-temperature incendiaries are used in conjunction with certain simulated nuclear HE tests. Smaller tests have been conducted to obtain explosive characteristics and phenomenology data. (Phenomenology, in this usage, pertains to the analysis of individual components separate from a larger system). Activities at PHETS are conducted primarily within three main test beds. Use of the Large, Intermediate, and Phenomenology test beds are based primarily on explosive magnitude. Charges are typically placed in or near test structures and are detonated by a remote timing and firing system hard-wired to the charge. In static tests conducted since the 1970s, explosive types included ANFO, nitromethane, TNT, and QM-100RA. Other explosives used in relatively smaller quantities per test include HMX, HEST, BLEST, DET, Pentolite, and Tritonal. Table 1 lists the approved bulk HE most commonly used on White Sands Missile Range (WSMR).

HE tests are proposed to continue at similar frequency and magnitude at PHETS as have occurred in the past, although there are no plans to conduct large-scale tests (4-8 kilotons

[KT]) at present. Limits placed on the testing frequency specified under the PHETS EA of 1987 (McMullan and Gould, 1987) have proved adequate to meet project goals, and a continuance of these limits is proposed under this *PEA* (Table 2). SHIST and Alt. SHIST will have static HE tests of up to 454 kg (1000 lb.) at the maximum rate of ten tests per year for each.

Table 1. Bulk high explosives commonly used on WSMR

Abbreviation	Name of Explosive
ANFO	Ammonium nitrate-fuel oil
C-4	Composition 4
RDX	Cyclotrimethylenetrinitramine
HMX	Cyclotetramethylenetetranitramine
Iregel-82, Iremite-62, QM-100, QM-100R	Emulsion explosives
NM	Nitromethane
PETN	Pentaerythritol tetranitrate
---	Pentolite
TNT	Trinitrotoluene
---	Tritonal

Table 2. Testing frequency by event magnitude at PHETS

Event Magnitude *(measured in English units)*	**Average Tests/Year**	**Maximum Tests/Year**
1000-lb test	5	10
100- & 2500-lb tests (charges fired in conjunction with large events to gauge weather conditions)	3 & 5	6 & 10
20-ton ANFO test	1	4
1- to 8-KT tests	0.5	1

2.1.2 Warhead Penetration Tests

Warhead penetration tests using the ground-based Davis Gun and Sandia Air Gun have been carried out at PHETS, SHIST, and Alt. SHIST. These tests use inert full-scale and reduced-scale models of penetrator warheads (e.g., full-scale I-800, 1/3-scale I-2000) that are fired downward at a steep angle through various media (such as soil, concrete, and bedrock) to evaluate the effectiveness of such weapons against hardened military structures. The Davis Gun, used in most of the full-scale tests, requires approximately 68 kg of M-30 explosive propellant for inert projectiles up to 908 kg (e.g., the BLU-109). This system employs a counter-weight which is propelled to a distance of up to several miles upon firing. The Sandia Air Gun uses a mixture of helium and compressed air for propulsion of reduced-scale warheads. The Mobile Ballistic Research System (MBRS) is a powder gun which fires a 50-kg projectile. At the PHETS Intermediate Test Bed, inert ground-based warheads have been fired into the tops of reinforced bunkers made with alternating concrete/soil layers to validate penetration prediction methodologies.

Warhead penetration tests into weathered granite have been conducted at SHIST and Alt. SHIST to evaluate technologies to defeat targets built in bedrock.

Air-delivered, non-boosted, laser guided bombs (e.g., GBU-24s, GBU-27s, and GBU-28s carrying warheads up to 1998 kg) have been used at PHETS to evaluate defeat mechanisms against hardened targets (mostly reinforced bunkers). SHIST has been used for numerous air-delivered bomb tests (live and inert) in weathered granite using mostly GBU-27s, GBU-28s, and BLU-109s, to evaluate warhead penetration and guidance systems performance. Alt. SHIST was the site of a single granite penetration test involving a guided missile and has been used for ground-based inert penetrator tests.

Warhead penetration testing (as described above) is proposed to continue at approximately the same frequency and magnitude as has occurred in the past. For evaluation purposes under this *PEA,* the total number of penetration tests per year using live ordnance of all types is 15 at PHETS, ten at SHIST, and three at Alt. SHIST. Inert warhead penetration tests (all types) per year will not exceed 30 each at PHETS, SHIST, and Alt. SHIST.

2.1.3 Collateral Damage Tests

Tests will continue to be conducted to analyze potential collateral damage resulting from the defeat of simulated chem/bio facilities through the use of simulants, taggants, rare earth materials, interferents, and other substances. The quantities, properties, and dispersal patterns of these test materials are used to assess the potential for actual weapons of mass destruction (WMD) materials to harm the human and natural environments near the defeated military targets. Typical test scenarios are designed to release simulant plumes from fortified test structures after detonation of static charges and air-delivered munitions.

Taggants and tracers incorporated in the simulant plume are then used to track the plume over substantial distances (approximately 30 km). Chemical simulants testing will be limited to a maximum of four releases per year at up to 15,142 L (4,000 gal) each or a maximum release of 60,567L (16,000 gal) per calendar year. This total includes open-air release of chemical simulants, which will be limited to 1893 L (500 gal) per open-air test. Biological simulants will be limited to four releases per calendar year with amounts not to exceed those given in Table 1, Appendix B. In summary, the frequency of collateral damage tests whereby simulants and/or other test materials are released will not exceed a total of eight per year.

Table 1, Appendix B lists potential test materials which include chemical and biological simulants, preservatives, thickeners, anticonglomerates, taggants, dyes, and interferents. Preservatives, thickeners, and anticonglomerates are additives to the chem/bio simulants to improve consistency. Interferents include smoke from the burning of various materials as part of certain test scenarios to evaluate equipment performance. To date, some of these substances have not been used on WSMR. Test materials not evaluated in previous WSMR environmental documents are evaluated individually regarding toxicity, propensity for bio-degradation, environmental fate, and/or other pertinent physical characteristics in Appendix C.

Substances that have been used in past tests to track simulant plumes, but are no longer employed, include the following taggants: diethyl phthalate, diatomaceous earth, yttrium oxide, gold dust, and silica glass beads. These taggants are considered "exotic" materials and can be used only once in a given region to obtain meaningful tracking data. The simulant phosphonic acid ("Albrite") is likewise not planned for further use. The possibility exists, nonetheless, that these materials may be used in some capacity for future tests and are therefore included in this *PEA*.

It is anticipated that as yet unspecified test materials will be used for testing which will exhibit essentially similar physical, chemical, and (in certain cases) biological characteristics as those currently approved. These unspecified materials will be compared with existing, approved materials and appropriately categorized. Materials used for testing will be constantly re-evaluated and replaced, when available, with more environmentally benign substances that also meet test requirement criteria. Any new materials selected for future tests will be employed to a degree consistent with the scope and nature of previous tests. Prior to testing, the use of any such materials will require additional environmental documentation.

Mixtures of test materials have not been used in the past but are planned for possible future tests. A possible example is a mixture of dimethyl methylphosphonate (DMMP), methyl salicylate (MeS), and Dowanol DPM glycol ether. Mixtures will be evaluated regarding toxicity, possible adverse reaction products, and other characteristics before being considered for use. Prior to testing, the use of mixtures will require additional environmental documentation.

Tests involving chemical and biological simulants and related substances are not foreseen at SHIST or Alt. SHIST.

2.1.4 Counter-terrorism Tests

Counter-terrorism tests are conducted primarily in the Intermediate Test Bed at PHETS to enhance the survivability of personnel and property against terrorist attacks. The Counter-terrorism Structure No. 1 (CTS-1) has been used to evaluate the impact of terrorist actions against a four-story building. Although most tests have involved relatively small quantities of explosives, the largest to date employed 2270 kg of C-4. Testing of this nature is proposed to continue into the foreseeable future and is evaluated at no more than ten tests per year under this *PEA*.

Counter-terrorism tests are not planned for SHIST or Alt. SHIST.

2.2 ADVANCED WEAPON SYSTEMS AND TEST CONCEPTS

2.2.1 Missiles, Bombs, and Submunitions

A number of advanced weapon systems are planned for evaluation in the future at the PHETS, SHIST, and Alt. SHIST. The use of weapons which substantially deviate from the specifications or destructive power of those presently authorized for testing at the PHETS, SHIST, and Alt. SHIST, will require additional environmental documentation.

The following list of weapon systems includes those that will likely be tested but is not inclusive of all weapons which may potentially be used in the future. Weapon systems suited to specific sites will be identified, if known:

- A variety of air-delivered, boosted, guided bombs, such as air-to-ground guided missiles (AGMs), with increasing standoff ranges, will be tested in the future. Various warhead types can be matched to the AGM (depending upon the specific model), with an approximately 340-to-363-kg warhead being typical.

- Tactical Missile Systems (TACMS) will be used more extensively in the future, using either a single live or inert warhead or a payload of non-explosive submunitions. An advanced penetrator version of this missile is planned for evaluation against hardened targets at PHETS and possibly at SHIST and Alt. SHIST.

- An additional weapon system to be tested at PHETS is the Joint Direct Attack Munitions (JDAMS). This is a tailkit section designed to attach to general purpose bombs, blast fragmentation bombs, and penetrator warheads (up to ~ 908 kg) to improve guidance during adverse weather conditions.

- The BGM-109 Tomahawk is a low-altitude, solid propellant cruise missile, originally configured to defeat fixed, land-based, mostly non-hardened targets. This missile is long-ranged (1,104 km) and uses inertial and terrain contour matching radar guidance with the capability of making in-flight course corrections. Tomahawks may be fitted with conventional warheads (approximately 454 kg) and with submunition payloads. The Tomahawk Baseline Improvement Plan has been initiated to upgrade the overall capabilities of this missile.

  Evaluation of Tomahawk missile variants in regard to the defeat of a greater variety of targets (including hardened targets) is a recent trend, and PHETS, SHIST, and Alt. SHIST may be suitable for such testing. An example of this type is the AGM-158 Joint Air-to-Surface Standoff Missile (JASSM), a precision cruise missile which uses either a multimode warhead or 454-kg penetrator.

2.2.2 Incendiary Munitions and Non-explosive Submunitions

Evaluation of incendiary munitions (excluding submunitions) will be conducted at PHETS and possibly SHIST and Alt. SHIST. Examples of munition type are armor-piercing incendiaries such as the PGU –13/B and PGU-14/B. These are air-to-ground munitions delivered generally, but not exclusively, by helicopter. Penetrating rounds containing depleted uranium will not be used.

Air-delivered (i.e., missile, rocket, or aircraft), non-explosive submunitions will be used at PHETS, SHIST, and Alt. SHIST. These submunitions will be used to evaluate dispersal patterns or other characteristics, and may also be configured as sensors for certain tests. Non-explosive, ground-borne small arms munitions may be evaluated at PHETS in the future, probably in a backpack system. Any non-explosive submunitions used will be readily identifiable, and thus will not be subject to the safety or unexploded ordnance (UXO) regulations governing the use of explosive ordnance.

2.2.3 Delivery Methods of Test Materials

Future test plans will involve various methods to disperse simulants and related substances (refer to Section 2.1.3 Collateral Damage Tests). The generation of simulant plumes may be accomplished by various means to achieve a suitable testing environment. Explosive dispersal, aerial and ground spraying, and targeting of simulated chem/bio facilities will be used in creating plumes. Tests may require open-air detonation of simulants rather than inside a test structure, as has been done previously. Open-air testing involving chemical simulants will be limited to a maximum amount of 1893 L (500 gal) per test. In cases where the mode of employment involves detonation of simulant products from a concrete pad, appropriately sized spill containment berms will be in place to prevent accidental losses before or during testing.

In all instances, weather conditions must be suitable on test days (i.e., wind speed will be less than 20 knots, and wind direction is not south-southwest). Specifc meteorological conditions will be pre-determined and described in each test description document. Current weather in the region will be closely monitored to reduce potential adverse effects prior to and during simulant tests. (Also refer to Section 5.2.3 Threatened and Endangered Species, *Fish* for further information).

2.2.4 Laser and Electromagnetic Systems

Laser systems will continue to be used in guidance and tracking tasks for air-delivered weapons. New concepts in laser technology emphasize target interaction phenomenology and improving laser power per unit weight toward greater military effectiveness. Other applications include communications, illumination and optical countermeasures.

It is conceivable that in the future, lasers may be developed and evaluated as weapon systems to defeat selected targets at PHETS. This may include Airborne Laser (ABL) weapons using a high-megawatt COIL-type (chemical oxygen iodine laser) beam, although presently this is an air-to-air defensive system undergoing development. Another system under development is the Advanced Tactical Laser (ATL), with capabilities for use in air-to-ground surgical strikes. These types of laser weapons would nominally match the testing history of PHETS. The use of such advanced systems would entail additional safety concerns, and close coordination with WSMR would be required to ensure all safety and environmental issues were resolved prior to commencing test activities.

Light Detecting and Ranging (LIDAR) uses laser light to scan materials suspended in the air (such as particles, aerosols, and gases) which reflect the light back toward a telescope-detector system. For simulant plume studies, hand-carried, and helicopter- or truck-mounted LIDAR equipment is used to track various chemical simulants as well as alumina, an additive for biological simulants. Mobile spectrometers are designed to detect plume taggants up to the boundary of WSMR.

Laser technology has been developed as a surveying tool, specifically termed automatic crater survey, with potential application at PHETS, SHIST, and Alt. SHIST. This system would accurately survey and map craters on the test beds using a laser device, and would aid in post-test analyses. Other future test concepts at PHETS, SHIST, and Alt. SHIST may involve optical, electro-optical, infrared, and robotic systems for strike and targeting functions against ground targets. Furthermore, advanced technology for bacterial plume tracking is being developed using biosensors which do not require deployment of taggants. Increasingly advanced sensors for target detection and selection are also likely planned for evaluation in the foreseeable future. An example of this technology is laser-radar (LADAR), a hybrid sensor system that generates high-resolution, three-dimensional imagery.

2.3 TARGET TYPES

The primary targets proposed for use at PHETS will continue to be hardened, underground or partially buried bunkers, and simulated command centers and WMD facilities. Additional above- and below-ground targets, which may be built of pre-constructed reinforced concrete, may also be built in support of specific programs.

Soft and mobile targets will be used in tests at PHETS. In support of small arms munition tests at PHETS, un-armored or lightly-armored wheeled or tracked vehicles will be used as targets. Also in the foreseeable future at PHETS, ground targets will include aircraft and missile systems.

Targets at SHIST include granite bedrock impact areas within the bounds of the proposed expansion of the site (discussed in section 2.6). Targets at Alt. SHIST will remain the granite bedrock impact areas within the bounds of existing test beds.

2.4 CONSTRUCTION

At PHETS, additional two-track dirt roads will be needed to provide better access to areas around test structures. New roads will facilitate the movement of test-related vehicles and assist in the placement of air monitoring systems. A three-story underground parking garage is planned for construction on the Large Test Bed for use as an air-to-ground target (refer to Section 2.3 Target Types).

The majority of the existing PHETS administrative area was built using trailers or temporary facilities. DTRA plans to upgrade the administrative area (Refer to Figure 2) by replacing the trailers/temporary structures with energy efficient preengineered buildings placed on concrete slabs. Two existing buildings within the administrative area, the test control building and lab, will be upgraded with restroom facilities. Also, two new facilities will be built, a maintenance building and a closed loop washrack with a recycling unit (no discharge); these will also be preengineered buildings placed on concrete slabs. The current water storage tank, water distribution system, and septic system will require expansion to allow plumbing to the new buildings and possible increase in use. The PHETS project will acquire all necessary permits prior to construction or modification (i.e. the required permit for the septic system). These construction activities will occur within the existing PHETS administrative area and will not require additional land.

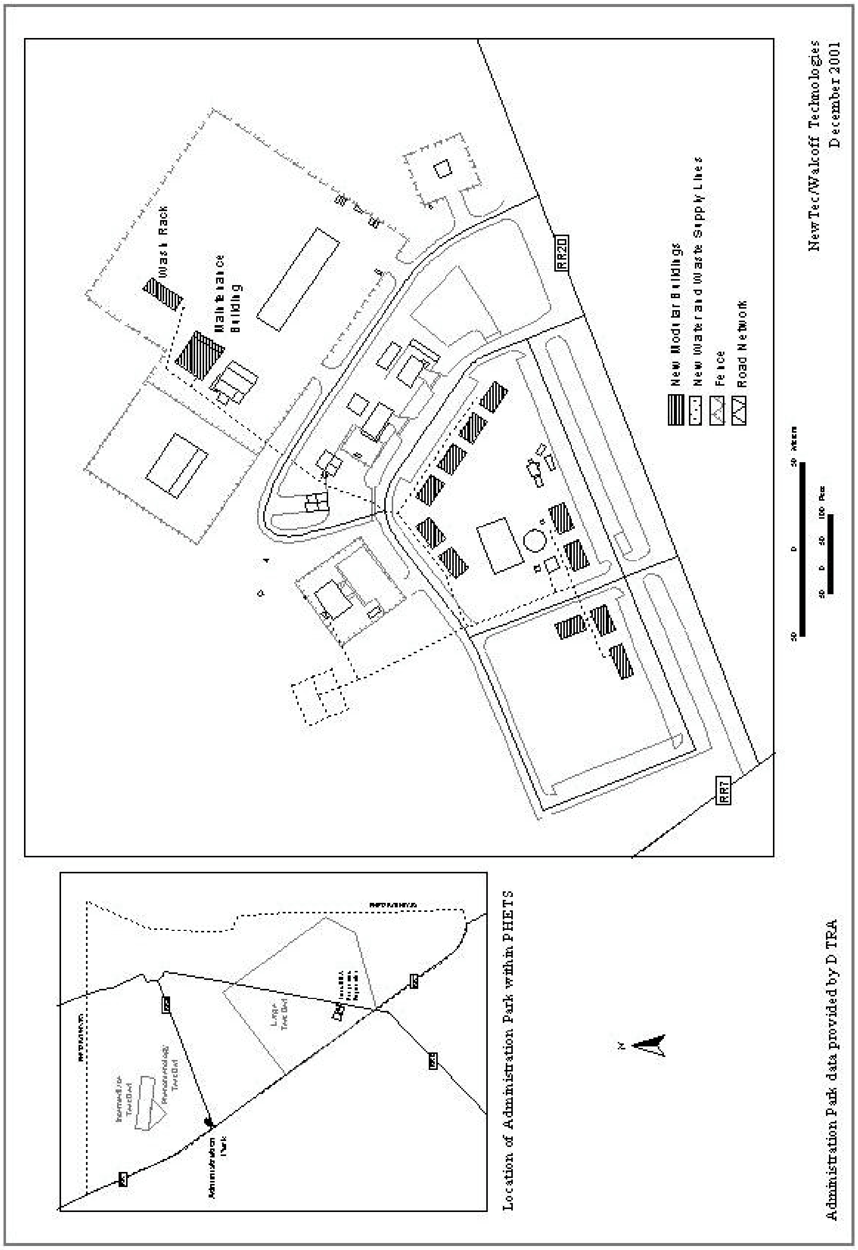

Figure 2. Detail of Future Five-Year Plan for PHETS Administration Park.

All construction activities will be treated under appropriate environmental documentation and planned so as to avoid areas with threatened, endangered or sensitive (TES) species and significant cultural resources. The occurrence of TES species and significant cultural resources in areas potentially affected by construction will require notification of WS-ES for further determination. Erosion control techniques will be taken to control dust generation at the site. Please refer to 5.1.4 Geology and Soils for more information.

No new construction is planned at SHIST or Alt. SHIST under this *PEA*.

2.5 EXPANSION OF LANDFILL

The landfill at PHETS will be expanded toward the north and west an additional 9 ha to accommodate disposal of test-related construction materials well into the foreseeable future. Materials allowed in the landfill are limited to concrete, reinforcing steel, wood, and masonry. The landfill is under application for State exemption status as a construction landfill. A ground water monitoring well has been drilled adjacent to the landfill to obtain water quality, lithology, and depth-to-water data needed for the exemption permit.

2.6 EXPANSION OF SHIST SITE

The continued use of SHIST for granite penetration tests will require expansion by an additional 14 ha (approximate) to access fresh bedrock. The eastern boundary is proposed to be extended approximately 150 m farther east, approximately following the prominent ridgeline which bounds the facility in that direction. The northern boundary will be shifted approximately 250 m beyond its present location.

2.7 SUMMARY OF PROPOSED ACTION

The proposed actions and the sites at which they are to occur are summarized below in Table 3.

Table 3. Summary of Proposed Actions

Proposed Action	Site		
	PHETS	SHIST	Alt. SHIST
Static HE Tests			
100 lb.	•	•	•
1000 lb.	•	•	•
2500 lb.	•		
20 ton	•		
1 to 8 KT	•		
High temperature incendiaries	•	•	•
Warhead penetration tests			
Live	•	•	•
Inert	•	•	•
Collateral damage tests			
Chemical simulants	•		
Biological simulants	•		
Taggants and tracers	•		
Interferents	•		
Counter-terrorism tests	•		
Laser and electromagnetic systems			
ABL	•		
ATL	•		
LIDAR	•		
LADAR	•		
Surveying laser technology	•	•	•
Targeting laser technology	•	•	•
Construction			
Above & below ground structures	•		
Roads	•		
Landfill Expansion	•		
Site Expansion		•	

3.0 ALTERNATIVES CONSIDERED

The preferred alternative represented by this Programmatic Environmental Assessment (*PEA*) is thoroughly described in Section 2.0 Proposed Action. Four additional alternatives were also considered:

- Changing the scope of the Proposed Action.
- Conducting testing at a facility other than White Sands Missile Range (WSMR).
- Conducting testing at sites on WSMR other than PHETS, SHIST and Alt. SHIST.
- No Action.

3.1 ALTERNATE ACTIONS

This *PEA* reflects all on-going activities and those that may reasonably develop in the foreseeable future. One alternative considered but not carried forward is to change the scope of the Proposed Action by increasing or decreasing the breadth of the proposed testing.

There are several ways in which the scope of the Proposed Action could be expanded. For example, new types of test materials, targets, advanced weapons, or delivery systems may be developed beyond those discussed in this *PEA*. Expansion of the Proposed Action is not viable at this time and is an alternative with the potential to increase environmental effects beyond those discussed in this document. Reducing the scope of the Proposed Action would lessen environmental effects; however, this alternative would not adequately address the need to test various weapons systems against hardened targets.

3.2 ALTERNATE TESTING FACILITIES

The alternative exists to use testing facilities other than WSMR. Some possible locations include: Nevada Test Site NV (NTS), China Lake CA, Dugway Proving Grounds UT, and Kirtland Air Force Base (AFB) NM.

Program requirements include the need for a large, remote location, and suitable infrastructure including test beds, hardened structures, communications and administrative facilities. Desirable general requirements include minimizing testing costs by using existing facilities, avoiding areas of environmental concern, and avoiding scheduling conflicts with other programs. Proximity to Kirtland AFB in New Mexico reduces travel for personnel to and from test locations. Many tests require specific weather conditions and air space adequate for dropping air-delivered munitions. Certain tests also require exposed granite with gentle slopes and vehicle access. Table 4 illustrates that some test requirements can be met at all of the alternative facilities; however, WSMR is the most suitable.

Individual tests are evaluated in the planning phase to determine which facility is most suitable based on test-specific objectives and requirements. The use of other facilities is a viable alternative for individual tests, but is a less desirable alternative on a programmatic level.

Table 4. Alternate Test Facilities

Requirements	Facilities				
	NTS	China Lake	Dugway	Kirtland AFB	WSMR
High Explosive Testing					
Large Test Area	•	•	•		•
Remote Location	•	•	•		•
Adequate Infrastructure	•		•		•
Suitable Weather Conditions	•	•			•
Penetration Testing					
Adequate Infrastructure	•				•
Remote Location	•	•	•		•
Presence of exposed granite bedrock		•	•		•
Collateral Effects Assessment					
Adequate Infrastructure				•	•
Suitable Environment for Simulant Use	•		•		•
Suitable Weather Conditions	•	•			•
Counter-terrorism Testing					
Adequate Infrastructure					•
General Requirements					
Adequate Air Space			•		•
High Explosive Clearance Limits	•	•	•		•
Environmental Issues	Low	Medium	Medium	Low	Low
Testing Costs (High Med Low)	High	High	High	Low	Medium
Proximity to Kirtland AFB (km)	1260	1226	1033	0	216
Single Tenant Test Site					•

3.3 ALTERNATE WSMR TEST SITES

PHETS, SHIST, and Alt. SHIST are the preferred test sites considered in this *PEA*. PHETS is an authorized high explosive (HE) test site which has been used for HE tests since the mid 1970s. It has a number of hardened structures and support infrastructure, which are currently being used for static tests, penetration tests, collateral damage assessments and counter-terrorism tests. Numerous archaeological and biological surveys have been conducted within the test beds and in surrounding areas affected by previous testing. Future use of the area in the context of this *PEA* is not expected to substantially alter the existing character of the site.

SHIST and Alt. SHIST sites were originally chosen for penetration tests because of their exposed granite, favorable slope characteristics, and road access. SHIST Site also has a history of explosive testing and was a disturbed area prior to its development as a formal site in 1993.

Salt Site is an authorized high explosive test site developed by the Air Force and used for the DIPOLE LIGHT test series (1994-1997). In order to meet testing objectives of the Proposed Action, Salt Site would require infrastructure upgrades including test structures and communications cabling, and further archaeological and biological surveys all of which would increase testing costs. Salt Site is also within two miles of Salt Creek which is considered essential habitat for the White Sands pupfish (*Cyprinodon tularosa*). This species is listed as threatened by the State of New Mexico and is a species of concern. Because of its proximity to Salt Creek, Salt Site is an alternative not carried forward.

There are additional areas of exposed granite on WSMR. While some of these sites may fit the criteria for slope and access, they are undeveloped. The benefits of creating a new site specifically for the Proposed Action are overshadowed by the associated environmental impact and financial costs.

3.4 NO ACTION ALTERNATIVE

No Action is a viable alternative. Pursuing the No Action alternative would allow facility operation and testing activities to continue as approved in the existing National Environmental Policy Act (NEPA) documentation discussed in Section 1.2. This alternative has limited value because it would not allow the flexibility to expand the scope of current testing activities to address emerging threats to the U.S. and its allies. This alternative is also limited by the time restrictions placed on existing NEPA documents, all of which will expire by 2008. At that time, the sites would be permanently closed. At PHETS, SHIST, and Alt. SHIST this would entail the returning of the sites to their original condition by re-contouring, filling in of craters and reseeding of the areas as detailed in earlier NEPA documents. This alternative would generate both positive and negative effects throughout the region. All of the personnel and other projects that utilize the area would have to find a new place to work and conduct testing. This may also necessitate the building of new testing areas that could incur further environmental effects. Potential positive effects include reductions in scheduling conflicts and roadblocks on the range; however, the negatives would far outweigh the positives under the No Action alternative. Expiration of existing documents will trigger review, analysis and additional NEPA documentation in the future before activities covered by those documents can continue.

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4.0 AFFECTED ENVIRONMENT

4.1 PHYSICAL RESOURCES

4.1.1 Location Description and Topography

PHETS, SHIST, and Alt. SHIST are located in the northern portion of White Sands Missile Range (WSMR) (Figures 3 and 4). PHETS, the largest of the three sites, is approximately 9068 ha with most activities taking place in three test beds totaling 2,123 ha. Located in Socorro County 21 km south of Stallion Range Center[1], PHETS lies on a nearly level alluvial plain in the northern Jornada del Muerto Basin. Overland flow is generally westward becoming less distinct as terrain flattens. Elevation ranges from 1418 m at Monitoring Well 00-1 in the Intermediate Test Bed to 1554 m at the southern end of the site.

SHIST and Alt. SHIST are situated on piedmont slopes draining toward the Tularosa Basin. SHIST covers 23 ha in Lincoln County 23 km southeast of PHETS[1]. The site is south of Oscura Gap on the western side of the Oscura Mountains. SHIST is moderately to steeply sloping, increasing in elevation to the east. Overland drainage is to the southwest. Elevation is approximately 1524 m.

Alt. SHIST covers 7 ha in the northern part of the San Andres Mountains of Sierra County approximately 26 km southeast of PHETS[1]. At an elevation of approximately 1463 m, Alt. SHIST is gently sloping, and drains to the northeast. Both sites are characterized by exposed or thinly covered granite bedrock.

4.1.2 Aesthetics and Visual Resources

PHETS is located in an area that has historically been used for high explosive tests, bombing, and missile impacts since the creation of WSMR in the 1940s. Trinity Site was the location of the first atomic bomb test conducted on July 16, 1945. Since then many missions follow a pattern of launching test vehicles from the southern portion of WSMR toward northern impact areas. Stallion WIT, 649 WIT, and the Northeast Center Impact Area (NECI) are part of the 90-Mile Impact Area located in the northern portion of WSMR near PHETS.

The Trinity Site National Historic Landmark (Trinity NHL), is a 19,976 ha portion of WSMR which received National Historic Landmark status in 1975. High explosive testing has continued to take place within the NHL beginning with the DICE THROW test conducted at PHETS in 1976. As a result of this historic use, much of the area has a disturbed appearance. Active disturbance is limited to three primary test beds containing nonpermanent single and multiple story test structures, test support equipment, berms, and an established road network. Berms and other light-colored bare soil areas are visually prominent against a background of natural vegetation. An administrative complex is located at the intersection of Range Road (RR) 7 and RR 20.

[1] All distances are measured to and from the Administration Area at PHETS.

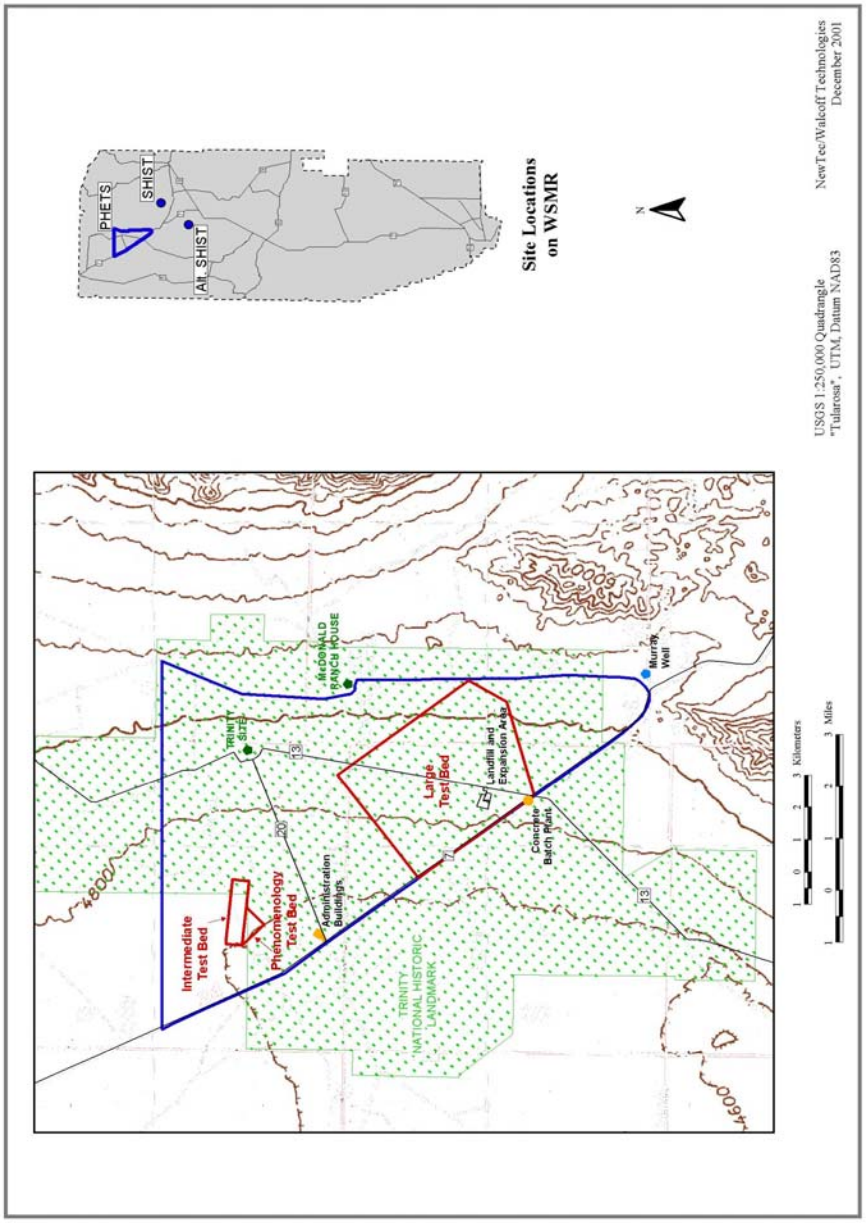

Figure 3. Location and topography of PHETS.

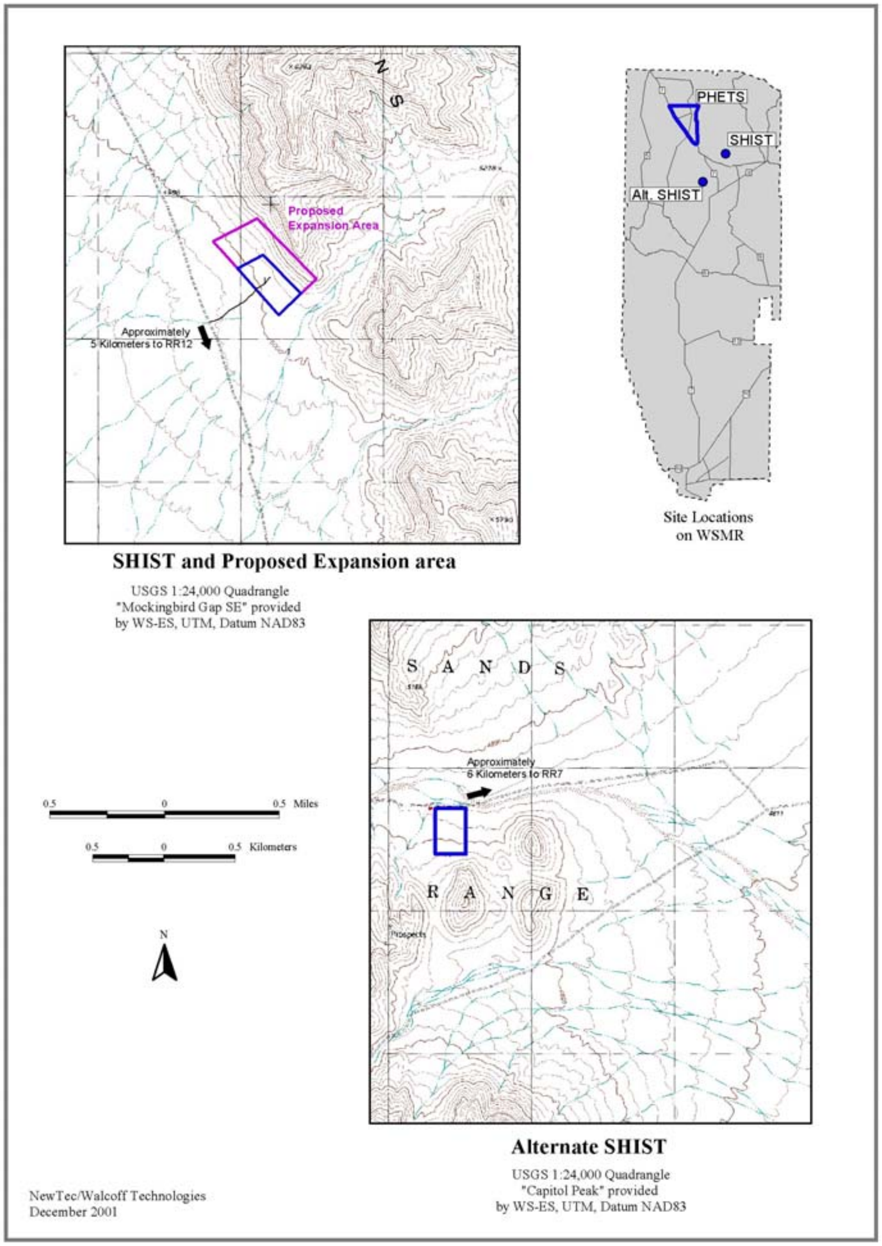

Figure 4. Location and topography of SHIST and Alternate SHIST.

SHIST and Alt. SHIST have been used for projectile penetration testing since the early 1990s. Earth-moving activities associated with projectile recovery have noticeably altered the appearance of the land surface. Fresh rock and bare soil areas contrast sharply with vegetated areas. Evidence of historic and on-going activities are visible from access roads to both sites.

4.1.3 Climate

South-central New Mexico is classified as a hot desert (Holechek, 1995). WSMR is located in the northern portion of the Chihuahuan Desert where droughts in the spring and fall are common. PHETS, SHIST, and Alt. SHIST lie close to the general elevational divide between arid and semi-arid climates (approximately 1520 m) (Schmidt, 1979). The summer rains that dominate precipitation patterns usually result from storms generated in the Gulf of Mexico. These storms are typically high intensity, short duration events that are not generally ideal for plant growth due to high evapotranspiration and rapid runoff. Summer precipitation generally contributes more than 50% of total rainfall annually. Winter storms, originating mostly from the Pacific Ocean, are generally less intense and longer in duration than summer storms. Natural vegetation has evolved under these conditions and developed mechanisms to maximize the benefits of this erratic precipitation (Dick-Peddie, 1993).

The ZURF weather station near PHETS reported recent precipitation ranging between 14.0 to 38.9 cm/year over a five-year period (1996-2000), with an average annual precipitation of 25.1 cm. Stations at higher elevations near SHIST and Alt. SHIST had higher precipitation. The Duquette station near the eastern boundary of PHETS and closest to SHIST, reported rainfall ranging from 21.3-34.3 cm with an annual average of 28.7 cm. The Mockingbird Gap station, north of Alt. SHIST, showed precipitation ranging from 18.5-39.6 cm and averaging 30.7 cm annually.

Temperatures in the same area are generally warm, often exceeding 38^{o}C for long periods in the summer. The warmest temperatures are reached in June and July with the lowest temperatures occurring in December and January. Average annual temperature for the area is 15^{o}C. Average maximum daytime temperature for the winter months is near 4^{o}C.

Spring winds are experienced from late February through early May. Strong westerly winds prohibit movement of precipitation from the Gulf of Mexico into the area creating dry spring months. Westerly winds during this time occasionally cause severe dust storms. These storms are a result of sparse vegetation and dry, loose soil. Dust storms occur most frequently in March and April, and more rarely in other months (Eschrich, 1992).

4.1.4 Geology and Soils

PHETS

PHETS is situated atop a thick sequence of Santa Fe Group (Tertiary-Quaternary) and Quaternary deposits which fill the Jornada del Muerto syncline, a down-warped region forming a structural basin. These materials are derived from alluvial, lacustrine, and eolian (wind-generated) sources, comprised of interbedded sands, silts, and clays. Pleistocene Lake Trinity (Neal, 1976), a feature which underlies much of PHETS, was likely a perennial lake during the last glacial maximum, approximately 18,000 years before present.

Alluvial fans slope westward from the nearby Mockingbird Gap Hills and the Oscura Mountains, tapering toward the basin. Late Holocene eolian activity has led to the formation of low-lying dunes and sheet deposits of gypsum and quartz sands throughout much of the region. Several small playas are also evident, consisting mainly of silt.

Bedrock exposures were not observed within the PHETS boundaries. A section of Permian rocks is exposed in the Mockingbird Gap Hills immediately east of PHETS and likely underlie much of the PHETS area (inferred from Weir, 1965 [Plate 1]). The overall depth to bedrock beneath the alluvial cover has been reported at over 122 m (McMullan and Gould, 1987).

The Nickel-Tencee soil association occurs extensively throughout the eastern margins of PHETS, mainly on alluvial fans derived from the nearby mountains (USDA, 1976). Soils within this association include gravelly fine sandy loam (Nickel) and very gravelly loam (Tencee). West of the Nickel-Tencee occurrence, the Berino-Dona Ana association (mostly sandy loams) is perhaps the most extensive soil mapping unit within PHETS. Other soil mapping units occurring at PHETS are Yesum-Holloman association, Lozier-Rock outcrop complex, and Gilland-Rock outcrop complex (USDA, 1976).

SHIST

SHIST Site is located on the western flanks of the Oscura Mountains, a northeast-dipping fault block range. The site lies mainly atop Precambrian granite, partially covered by a veneer of Quaternary alluvium. To the east and upslope, the site terminates in a section of lower Paleozoic marine sedimentary rocks. Quaternary alluvial fans cover the western part of the site, grading toward the main local drainage. The western boundary fault of the Oscura Mountains lies buried beneath alluvium west of SHIST, where Precambrian granite is in fault contact with younger upper Paleozoic rocks (inferred from Bachman, 1968).

The Soil Survey of WSMR places SHIST in the Rock land, cool mapping unit (USDA, 1976). Included in this unit are bedrock exposures, stony land, and shallow soils interspersed between rock outcrops.

Alternate SHIST

Alt. SHIST is situated on a gently sloping exposure of Precambrian granite, which is locally covered by a veneer of Quaternary alluvium (Bachman and Harbour, 1970). Immediately west of the site, an outcrop of Pennsylvanian Lead Camp Limestone occurs adjacent to a buried fault contact with the granite.

The soil mapping unit for Alt. SHIST is designated Rock land, warm (USDA, 1976). Soils are thin and stony, and occur in patches atop the underlying granite bedrock.

4.1.5 Water Resources

Surface Water

There are no perennial streams or surface water bodies in PHETS, SHIST, and Alt. SHIST. Normal rainfall infiltrates rapidly in the region; however, heavy rainstorms can create short-duration overland flows and occasional ponds within natural depressions. In addition, several earthen water catchments, probably abandoned ranching-era stock tanks, were noted at PHETS. Storm water runoff from PHETS drains westward across a broad alluvial plain toward the Rio Grande to the central part of the Jornada del Muerto Basin. To the south and east, SHIST and Alt. SHIST drain toward the Tularosa Basin, a closed regional depression.

Ground Water

Alluvial bolson deposits comprise most of the aquifers in the Jornada del Muerto and Tularosa basins. Depth to ground water in the Jornada del Muerto basin has been reported 4-178 m below the land surface (Roybal, 1991). The 1988 well record for the PHETS administrative area reported the water table at 19 m. Other wells in the PHETS area have widely varying water table depths: examples include the Story Well (4 m) (Roybal, 1991), the C. Green Well (14 m) (Weir, 1965), the Foster East Well (28 m), Murray Well (59 m), the Mc Donald Headquarters Well (105 m) (Weir, 1965), and the DC-1 Well (77 m) (USGS staff, 1985). Depth-to-water generally increases from west to east at PHETS, reflecting the increasing thickness of alluvium toward the Oscura Mountains. A hydrologic map of WSMR (Weir, 1965) indicates the water table gradient sloping toward the west-northwest, also the likely general direction of any subsurface flow.

Ground water monitoring wells were drilled to evaluate possible testing-related cumulative impacts (refer to Section 6.2.2). Figure 5 shows the location of these and several historic wells in the PHETS area. In the Intermediate Test Bed, Monitoring Well (MW) 00-1 was completed to a depth of 27 m below the land surface, and ground water was encountered at 22 m. The other new monitoring wells MW00-2 and MW01-3 have slightly higher ground water elevations, suggesting a ground water flow direction toward the north-northwest (Figure 5). This interpretation of flow direction also agrees with the water table contour map of Weir (1965). Near the boundary of the proposed landfill expansion area, well MW 00-2 finished at a total depth of 66 m, and the water table was reached at 60 m. MW 01-3 was completed upslope from the landfill and reached water at 77 m.

Ground water throughout PHETS is essentially non-potable and classified as brackish, defined as 1,000-10,000 mg/L total dissolved solids (TDS) (Freeze and Cherry, 1979). Data from three historic wells in the area easily exceed the State standard (20.6.2NMAC, 15Jan01) of 1,000 mg/L and Federal standard (40CFR143) of 500 mg/L (e.g., 3310, 3520, and 3700 mg/L). Sulfate concentration in these waters is approximately 2200-2500 mg/L, far higher than the State standard of 600 mg/L (20.6.2NMAC, 15Jan01) and Federal standard (40CFR143) of 250 mg/L. There are no currently existing water sources that may be used as a potable water supply on PHETS.

Selected analytical results from year 2001 sampling of the three new monitoring wells are presented in Table 5. Sulfate, nitrate, and TDS content closely match historic well data for the area (Weir, 1965; Roybal, 1991). The chemical simulant TEP, used in previous collateral damage tests, was not detected in any of the samples. Subsequent sampling and analysis of ground water planned in the future at PHETS will assist in detection of adverse trends in water quality (refer to Section 6.2.2 Potential Ground Water Contamination).

Table 5 Selected analytical results for PHETS monitoring wells.

Well Name	UTM Coordinates, NAD83	Sampling Date	Total Dissolved Soilds (mg/L)	Sulfate (mg/L)	Nitrate (mg/L)	Petroleum Hydrocarbon In water (mg/L)	Triethyl Phosphate (μg/L)
MW 00-1	N3727733 E357836	06JUN2001	3289	2081	3.03	1.32	Not Detected
MW 00-2	N3720483 E361300	17OCT2001	3847	2536	8.8	0.0208	Not Detected
MW 01-3	N3721266 E363197	17OCT2001	3728	2260	10.7	0.177	Not Detected

Water for construction, project activities, or personnel use is trucked in from outside sources, usually from wells at Stallion Range Center.

The Mockingbird Gap well is nearest to SHIST, with a reported depth to water at 23 m. Ground water at SHIST is transitory and effectively limited by the shallow bedrock contact in the area. Alluvial cover within the SHIST boundaries ranges from 0 to approximately 15 m. Ground water is expected to accumulate in the alluvium atop the bedrock following significant rainfall events but does not persist for long.

Alt. SHIST is situated on granite bedrock in the foothills north of Capitol Peak, covered by a veneer of alluvium in places. Other than seismic boreholes drilled for past tests, no water wells exist in the immediate vicinity. Burris Well, located approximately 1.6 km west of Alt. SHIST, was drilled in valley-fill alluvium and has a reported water table depth of 11 m (Weir, 1965).

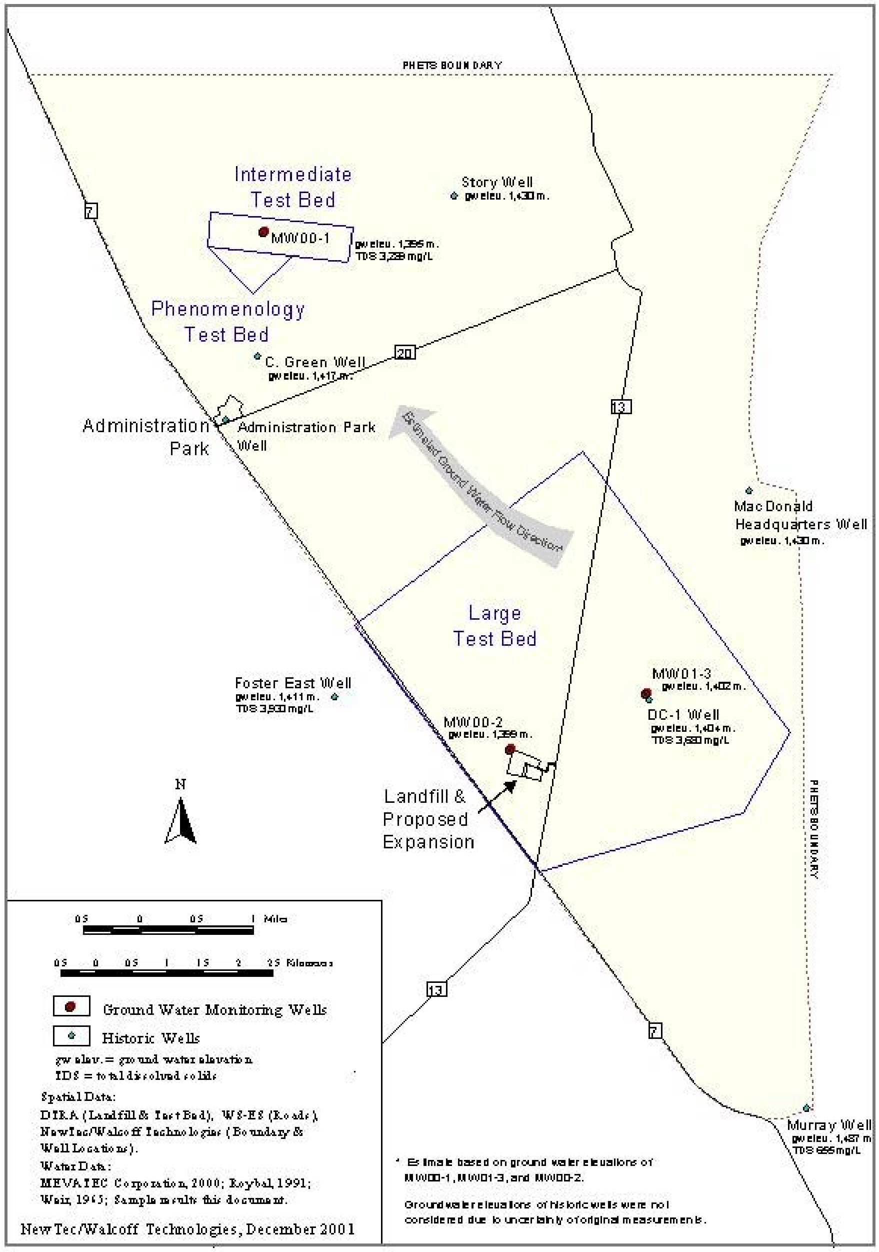

Figure 5. Ground Water monitoring and historic wells at PHETS.

4.2 BIOLOGICAL RESOURCES

4.2.1 Flora

PHETS, SHIST, and Alt. SHIST all lie at the northern margin of the Chihuahuan Desert and are characterized by flora adapted to the hot and dry climatic conditions of the region. Precipitation patterns, elevation, soil type, aspect, and slope are the primary environmental factors influencing distribution of vegetation types. Table 5 shows the size, proportion, and primary species composition of each vegetation type identified at the three sites. Information for PHETS was taken from an analysis of WSMR vegetation done by the New Mexico Natural Heritage Program (NMNHP). Classification of the vegetation types follows that presented in *The Vegetation of White Sands Missile Range Volume II*, and the vegetation types discussed here are presented in more detail in that document (Muldavin, 1998).

The scale of the NMNHP data is too coarse to provide a complete description of the SHIST and Alt. SHIST sites which are much smaller than PHETS. To compensate for the difference in scale, SHIST and Alt. SHIST were evaluated through field investigation. A detailed description of species composition and a plant list for all three sites is provided in the Biological Survey Report prepared in conjunction with this *PEA* and found in Appendix D.

PHETS is a large area dominated by four major vegetation types common in the northern Jornada del Muerto and Tularosa Basins. These communities include Mixed Lowland Desert Scrub, Lowland Basin Grassland, Sandsage Shrubland, and Vegetated Gypsum Outcrop, occurring in sizeable landscape patches across the PHETS area with a mixed mosaic of vegetation types at the southern end of the site. Within these major vegetation types are small inclusions of Mesquite Shrubland and larger inclusions of Creosote Shrubland and Desert Plains Grassland. Areas of Military Disturbance and roads are also a major landscape feature of the PHETS area.

SHIST Site contains species typical of Creosote Shrubland. This vegetation type occurs commonly on gravelly alluvial fan piedmont areas. In undisturbed areas at SHIST, creosotebush is the dominant shrub occurring with honey mesquite, fluffgrass and bush muhly. The Military Disturbance at SHIST includes areas of active testing with on-going recovery and reclamation taking place. These areas are bare or sparsely vegetated with colonizing species.

Alt. SHIST has the vegetative characteristics of a Black Grama Grassland with sand sagebrush as the primary shrub. The active testing area is designated Military Disturbance. This area is relatively free of vegetation with some colonizing species of grasses and forbs present. There are two small arroyos crossing the site to the east and west of the active area. These arroyos are characterized by Apache plume and other riparian species common to WSMR.

Table 6. Major Vegetation Types at PHETS, SHIST, and Alternate SHIST

Vegetation Type	Size		% of Site	Primary Species Composition[3]
	Ha	Ac		
PHETS[1]				
Mixed Lowland Desert Scrub	2709	6693	29.7	creosotebush, tarbush, fourwing saltbush, alkali sacaton, bush muhly
Lowland Basin Grassland	2073	5123	21.1	alkali sacaton, tobosagrass, mesquite, fourwing saltbush
Sandsage Shrubland	1257	3106	13.8	sand sagebrush, black grama
Vegetated Gypsum Outcrop	950	2348	10.5	gyp dropseed, hairy coldenia
Military Disturbance and Roads	806	1993	8.7	three-awn grasses, fluffgrass, silver-leaf nightshade
Creosotebush Shrubland	690	1706	7.6	creosote, alkali sacaton, bush muhly, black grama, fluffgrass
Desert Plains Grassland	463	1145	5.2	black grama, mesa dropseed, soaptree yucca, torrey jointfir
Mesquite Shrubland	119	294	1.4	honey mesquite, mesa dropseed
SHIST[2]				
Creosotebush Shrubland	16	40	71	creosote, fluffgrass, bush muhly, various cactus spp on upland slope
Military Disturbance and Roads	8	16	29	three-awn grasses, fluffgrass, silver-leaf nightshade
Alt SHIST[2]				
Black Grama Grassland	3	8	47	black grama, sideoats grama, soaptree yucca, sand sagebrush
Riparian Areas	1	2	12	Apache plume
Military Disturbance and Roads	3	7	41	three-awn grasses, fluffgrass, silver-leaf nightshade

[1] data from New Mexico Natural Heritage Program
[2] data from Walcoff field personnel
[3] common names correspond to scientific names in Muldavin (1998) and Appendix D

4.2.2 Fauna

Over 300 species of birds are known or expected to occur on WSMR, including year-round residents and seasonal migrants. Common species potentially include quail, mourning doves, roadrunners, hawks, owls, ravens, turkey vultures, sparrows, wrens, flycatchers and a variety of other songbirds.

Common large mammals potentially inhabiting the sites include pronghorn antelope, mule deer, oryx, coyote, black-tailed jackrabbit, and desert cottontail. The three sites also potentially support a variety of small mammals including woodrats, kangaroo rats, mice, bats, and pocket gophers.

The mixed shrublands, grasslands, and vegetated gypsum areas typical of PHETS, SHIST, and Alt. SHIST support healthy populations of reptiles. Common lizards include horned lizards, whiptails, side-blotched lizards, collared lizards, and leopard lizards. Snakes include coachwhips, rattlesnakes, and gopher snakes. The desert box turtle and three species of toads also potentially inhabit these areas.

Obtaining a thorough inventory of invertebrates is problematic, with many insect, arachnid, and aquatic species remaining undocumented. At least 17 genera of land snails have been identified in several studies along the San Andres and Oscura Mountains, some of which may potentially occur at PHETS, SHIST, or Alt. SHIST (DES, 1998).

A list of species actually detected or observed at the three sites during biological surveys is available in Appendix D.

4.2.3 Threatened, Endangered, or Sensitive Species

A complete list of threatened, endangered, or sensitive (TES) species known or expected to occur on WSMR can be found in Appendix E.

Flora

Based on NMNHP data, and information from WS-ES, four WSMR species of interest (SOIs) may potentially occur at PHETS, SHIST, or Alt. SHIST (pers. comm. Dave Anderson, WS-ES, land manager). SOI species are plants that WS-ES monitors for location and abundance based on four criteria including previous Federal or State listing, rarity on WSMR, species useful for land rehabilitation, or species with spatially restricted habitat. These species receive no legal protection.

Fauna

Desert grassland communities below 1,800 m at PHETS have been identified as potential aplomado falcon habitat (STEWS-NRES, 1997; see Appendix F). The aplomado falcon is considered an endangered species by both State and Federal agencies. Other TES species potentially occurring at one or more of the three sites as either transients, seasonal, or year-round residents are also listed in Table 6.

Table 7. Listed TES and SOI species potentially occurring at PHETS, SHIST, and Alternate SHIST

Species	Scientific Name	Federal Status	NM Status	WSMR Status	Location of Concern
FLORA					
Cory jointfir	*Ephedra coryi*			SOI	Alt. SHIST
Dagger thorn cholla	*Opuntia clavata*			SOI	PHETS, SHIST, Alt. SHIST
Pineapple cactus	*Neolloydia intertexta*			SOI	PHETS, SHIST
Grama grass cactus	*Pediocactus papyracanthus*			SOI	PHETS
FAUNA					
Birds					
American Peregrine Falcon	*Falco peregrinus anatum*		T		PHETS, SHIST, Alt. SHIST
Aplomado Falcon	*Falco femoralis septentrionalis*	E	E		PHETS
Baird's Sparrow	*Ammodramus bairdii*		T		PHETS
Burrowing Owl	*Athene cunicularia*			SOI	PHETS, SHIST, Alt. SHIST
Gray Vireo	*Vireo vicinior*		T		PHETS, SHIST

Species	Scientific Name	Federal Status	NM Status	WSMR Status	Location of Concern
					Alt. SHIST
Loggerhead Shrike	*Lanius ludovicianus*			SOI	PHETS, SHIST, Alt. SHIST
Lucifers Hummingbird	*Calothorax lucifer*		T		SHIST, Alt SHIST
Violet-crowned Hummingbird	*Amazalia violiceps*		T		SHIST, Alt. SHIST
Mammals					
Black-tailed Prairie Dog	*Cynomys ludovicianus*	CW			PHETS
Desert Bighorn Sheep	*Ovis canadensis mexicana*		E		Alt. SHIST
Oscura Colorado Mountain Chipmunk	*Tamias quadrivittatus oscuraensis*		T		SHIST
Spotted Bat	*Euderma maculatum*		T		PHETS, SHIST, Alt. SHIST

E=Endangered, T=Threatened, CW=Candidate with Warranted but Precluded determination, SOI=Species of Interest

4.3 CULTURAL RESOURCES

Human habitation of the WSMR region represents an almost continuous occupational sequence encompassing a period from approximately 9,000 B.C. to the present and includes numerous Paleoindian, Archaic, Formative, Protohistoric and Historic period cultural resources. At PHETS, SHIST, and Alt. SHIST previous archaeological surveys have identified many archaeological sites, some of which may be potentially eligible for the National Register of Historic Places.

4.3.1 Previous Archaeological Surveys in the PHETS Area

Most of the PHETS area is within the boundaries of the Trinity National Historic Landmark. The Trinity Site is both a National Register-listed site and a National Historic Landmark. It covers approximately 14,736 ha and was the test area for the first manmade nuclear detonation. Historic features include Ground Zero where the first nuclear bomb was detonated in 1945, the base camp where the scientists and support group lived, four instrumentation bunkers, and three observation bunkers. Also within Trinity National Historic Landmark, McDonald Ranch House is a National Register-listed property where the bomb was assembled.

Over a dozen archaeological surveys have been conducted in the PHETS area. Many of these were done for specific tests. Numerous archaeological sites have been recorded, both prehistoric and historic. Figure 6 shows the location of surveys. Table 7 summarizes the previous work and the number of archaeological sites found.

Table 8. Previous Archaeological Surveys for the PHETS area

Date	Title	Author	No. of Sites
1977	An archaeological survey of the Roland Test Facilities Complex and the CEI-3 Aerial Launcher Site, White Sands Missile Range, Dona Ana and Socorro Counties, New Mexico	Beckett and Shelley	8
1980	An Archaeological Survey of Fixed Camera Complexes, Otero County, Four Vandal Launch Sites, Dona Ana County, and Fragmentation Hazard Investigation Bonfire Test Area, Socorro County, White Sands Missile Range, New Mexico	Kirkpatrick	1
1981	An Archaeological Survey of the Mill Race Project, Socorro County, New Mexico	Laumbach	5
1982	Archaeological Survey of Two Proposed Military Use Areas on the White Sands Missile Range, Southcentral New Mexico: Permanent High Explosive Test Site (Strain Path Test), Infrared Test Range (M-1 Tank Test)	Schermer	0
1983	Archaeological Survey of a Proposed Military Use Area on the White Sands Missile Range, Direct Course	Schermer	8
1984	Archaeological Survey of a Military Use Area on the White Sands Missile Range, Southcentral New Mexico	Fifield and Kugler	0
1986	The Misty Pictures Archaeological Project: An Archaeological Survey of 10 Acres near the Trinity Site, White Sands Missile Range, Socorro County, New Mexico	Clifton	5
1987	An Archaeological Survey of 75 Acres for a Precision Test Bed, White Sands Missile Range, Socorro County, New Mexico	Clifton	1
1988	Archaeological Survey of 14.4 Acres near Trinity Site, White Sands Missile Range, Socorro County, New Mexico	Sale and Shields	1
1991	The Aerial Cable Test Capability Project: An Archaeological Evaluation of the Jim Site and Fairview Alternatives, White Sands Missile Range, New Mexico	Human Systems Research	69
1992	MAI Project 800	Mariah Assoc.	1
1993	Additional Archaeological Survey for the Aerial Cable Test Capability Site, White Sands Missile Range, Socorro County, New Mexico	Sechrist	10 new, 4 prev. recorded
1993	Survey of an Access Corridor and Testing of Three Sites for the DNA Dipole Test Bed, White Sands Missile Range, Socorro County, New Mexico	Webb	3 prev. recorded
1995	An Archaeological Survey of the Fiber Optics Cable Right-of-way for the Eastern Test Support Network, White Sands Missile Range, New Mexico	Medez, Russell, Laumbach	8
1996	Trinity at Fifty: Technical Report No. 2, Archaeological Survey and Reconnaissance of the Trinity Site Communications Lines, White Sands Missile Range, Socorro County, New Mexico	Medez, Hart, Kemrer and Webb	6 new, 4 prev. recorded
1997	An Archaeological Survey of 2.79 Hectares (6.9Acres) for Explosive Bunkers Near the Phets Administration Area on White Sands Missile Range, Socorro County, New Mexico	Hilley	0
1997	Trinity at Fifty: Technical Report 1, Trinity Site National Historic Landmark, White Sands Missile Range, Socorro County, New Mexico	Reider and Lawson	13

4.3.2 Previous Archaeological Surveys at SHIST

The existing SHIST area was surveyed by Geery and Hoyt (1977) and by Webb (1993). A large Archaic period site was recorded in the SHIST area and is currently fenced for protection. Another smaller site was identified immediately outside the original SHIST test site. Several other archaeological surveys have been conducted in areas around SHIST. Many archaeological sites have been documented in those areas, but are not directly affected by actions at SHIST.

4.3.3 Previous Archaeological Surveys at Alternate SHIST

Several cultural resource surveys have been conducted in and around the area encompassing Alt. SHIST (Russell and Kirkpatrick, 1997; Phillips, 1996; Hart and Slensker, 1995; and Shields, 1990). Several Archaic period sites were recorded that may contain information significant to the prehistory of the area. One large site with components dating from Paleoindian through the Jornada Mogollon was also recorded and tested to determine potential for buried resources.

4.4 PRESENT LAND USE

4.4.1 Military Testing Programs

PHETS is an authorized high explosive (HE) test site which has been used for non-nuclear HE tests since the mid 1970s. Since the early 1990s it has also been used to evaluate the effectiveness of various weapons systems against hardened targets, collateral damage assessments and for various counter-terrorism tests. Since the 1990s SHIST and Alt. SHIST have been used for ground penetration testing of inert projectiles.

A substantial investment has been in infrastructure to support these different types of test activities. PHETS has three dedicated test beds, several hardened test structures, and support facilities including administration buildings, concrete batch plant, construction landfill, and cable yard. Instrumentation and optic areas and an extensive network of roads within the test beds also support test activities. The SHIST and Alt. SHIST sites are small and require little or no infrastructure for their use.

The northern portion of WSMR also hosts a number of other military facilities. The Aerial Cable Range, Large Blast/Thermal Simulator (LB/TS), Zumwalt Test Track, the 649 WIT, and Stallion WIT all operate near the PHETS area.

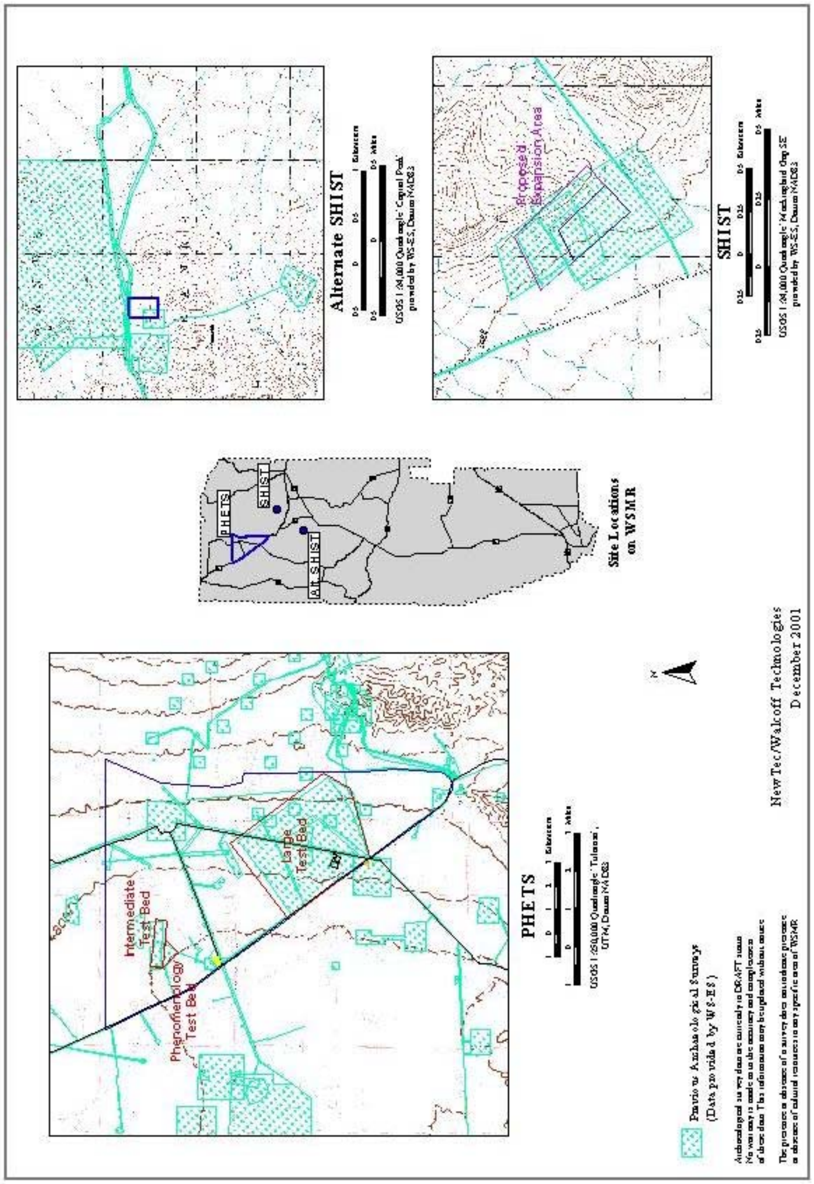

Figure 6. Previous archaeological surveys at PHETS, SHIST, and Alternate SHIST.

4.4.2 Recreation

Public access to the northern portion of WSMR is restricted; however, two recreational activities occur in the proximity of PHETS, SHIST, and Alt. SHIST. Trinity Site is open for public tours twice a year the first Saturdays in April and October. Trinity Site and PHETS are both located on the Trinity National Historic Landmark. Tours access the Trinity Site via RR 20 bisecting PHETS.

Hunting is allowed on WSMR on a non-interference basis during weekends, holidays, and Range non-duty days. Hunting is allowed only during those seasons and for those species listed in the current New Mexico Department of Game and Fish (NMDGF) proclamation. All hunting activities on WSMR are done in compliance with NMDGF regulations, State and Federal laws, Army regulations, and Range policies and regulations. PHETS is not located in a designated hunting zone. SHIST Site is within Hunting Zone 9, and Alt. SHIST is in Hunting Zone 4.

4.4.3 Airspace

WSMR controls 13 restricted airspace areas. These are designated for hazardous activities including live ordnance delivery, missile firings, and laser tests by the Federal Aviation Administration (FAA). The use of WSMR airspace by civil and military aircraft is scheduled and authorized by WSMR Range Control.

PHETS, SHIST, and Alt. SHIST are within a region of airspace that encompasses all of WSMR and small adjacent areas. Four additional regions of airspace cover the PHETS, SHIST, and Alt. SHIST areas. These are generally reserved for tactical and supersonic flight training conducted by Holloman Air Force Base.

4.5 AIR QUALITY

New Mexico is divided into Air Quality Control Regions (AQCR) as specified by the United States Environmental Protection Agency (EPA) and the New Mexico Environment Department (NMED). The northern area of WSMR that falls within Socorro County, including PHETS, is in AQCR 156. Most of WSMR, including SHIST and Alt. SHIST, is located within AQCR 153. The EPA assesses air quality according to six criteria pollutants: carbon monoxide (CO), ozone (O_3), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), respirable particulate matter (PM_{10}), and lead. Primary National Ambient Air Quality Standards (NAAQS) are defined to protect public health with an additional margin of safety, while secondary NAAQS are set with regard to public welfare such as economic and environmental values. WSMR is located in areas considered to be in attainment of NAAQS.

Title V of the Clean Air Act outlines the requirements for State-issued operating permits. WSMR has a Title V permit. Permitted air pollution sources in the project area include two concrete batch plants at PHETS and one propane boiler.

4.6 NOISE AND BLAST

Major sources of noise at WSMR include missile launches, sonic booms, ordnance explosions, low-altitude military jet traffic, aircraft drone overflights, gun fire, military helicopters, and general vehicle traffic (U.S. Army, 1998).

WSMR activities are required to follow standards determined by the Occupational Safety and Health Administration (OSHA) Act of 1970, which protects workers from potentially hazardous occupational noise exposures. OSHA regulations establish a maximum noise level of 90 dBA for a continuous 8-hr exposure during a working day, and higher sound levels for shorter exposure times. Army regulations require that hearing protection be used when noise levels are greater than 85 dBA.

Traffic along established roads and other human activity add to background noise levels in accessible areas of WSMR. The average automobile traveling at 50-100 kph (30-60 mph) produces 60-75 dBA at a distance of 15 m, which is considered representative of vehicle-generated noise throughout the area.

4.7 RADIATION

Ionizing radiation, usually generated from radioactive decay or high-energy sources, is potentially damaging to biological cellular structure. High voltage radar equipment is a source of x-rays, a form of ionizing radiation. Low levels of ionizing radiation are present in certain types of standard military sights containing thorium-coated lenses and in a variety of self-luminous devices such as vehicle gauges, dials, switches, compasses, watches, muzzle reference sensors, etc. Many of these devices have been or are currently being replaced by non-radioactive materials.

Potential sources of non-ionizing radiation include lasers and radars. Lasers emit high-intensity light and are used for tracking and sighting purposes. Radar units produce microwave (heat) radiation in addition to x-ray (ionizing) radiation.

Radiation safety issues are the responsibility of the WSMR Radiation Protection Division, which ensures compliance of rules and regulations outlined by the U.S. Nuclear Regulatory Commission and Army Regulation 11-9 (1999). These regulations focus on establishing policies and procedures for use, licensing, disposal, transportation, safety design, and inventory control of ionizing and non-ionizing radiation sources. Radiation exposure standards, dosimetry (measurements of radiation doses) and accident reporting instructions are also addressed.

4.8 HAZARDOUS WASTE

WSMR Regulation 200-1, Environmental Hazardous Waste Management (U.S. Department of the Army, 1991b), provides guidelines for the handling and management of hazardous waste and ensures compliance with all Federal, State, and local laws regulating generation, handling, treatment, storage, and disposal of hazardous wastes. Critical or hazardous material and hazardous wastes are recovered immediately, transported, stored, and disposed of in accordance with WSMR Regulation 200-1. Hazardous materials stored at PHETS include high explosives (HE), chem/bio materials, construction products and petroleum, oil, and lubricant (POL) products. The type and degree of hazard for these materials can be found in Appendix B. Waste products from DTRA that could potentially be defined as hazardous (e.g., spent or excess test materials, paints, glues, POL products, and process waste from the proposed washrack) will be analyzed for such determination. If the product is hazardous it will be handled in accordance with WSMR Regulation 200-1. There is a POL pick-up area in the PHETS Administration Park for small amounts of POL waste. Non-hazardous waste will be handled as solid waste or non-regulated waste.

No hazardous or toxic materials will be stored at SHIST or Alt. SHIST. Wastes potentially occurring at these sites include POL products from vehicles and equipment, and will be disposed of at the PHETS POL pick-up area.

4.9 HUMAN HEALTH AND SAFETY

General health and safety protocols for WSMR personnel are addressed in various Federal, State, and WSMR guidelines, rules and regulations. Two comprehensive programs addressing these issues are Army Regulation 385-100 and WSMR Regulation 385-18. Detailed standard operating procedures (SOPs) have been established to fulfill health and safety requirements. WSMR is a participant in the Emergency Operations Plan, which establishes a response network involving Federal, State, and local agencies.

WSMR Flight Safety has the authority to terminate flight tests to protect personnel and equipment. Flight Safety is required to approve all flight tests, based on a comprehensive review of safety factors, risk analysis, and relevant SOPs.

Other safety issues concerning WSMR personnel include release of hazardous substances, and explosion of various munitions and ordnances. The WSMR work environment also includes various environmental hazards, such as venomous snakes and spiders. Hantavirus, a disease contracted by humans in contact with urine or droppings of deer mice, may occur on WSMR.

4.10 SOCIOECONOMICS AND INFRASTRUCTURE

4.10.1 Economy

The economic region of influence for WSMR activities include surrounding communities in Doña Ana, Lincoln, Otero, Sierra, and Socorro Counties in NM, and El Paso County in Texas. WSMR injects approximately $1,000,000/day into the economy of the region including monies from salary and local contract dollars. (WSMR Public Relations website, 2001).

Most personnel supporting operations in the project area are employed as government or contract workers through WSMR or Kirtland Air Force Base. The dominant economic force in the region is the Federal government.

4.10.2 Utilities

Electricity is provided to WSMR from several commercial sources. The Information Operation Directorate is responsible for communication support to WSMR, including distribution, maintenance, and scheduling. Off-range telephone services are provided by

QWest Communications. Cellular phones or radios are required for personnel traveling north of U. S. Highway 70 on WSMR.

The PHETS administrative area has permanent utilities service. Water for the PHETS site is obtained from the Stallion Range Center water system and delivered to a storage tank at PHETS via tank truck. This water is non-potable and used for sanitary purposes. Bottled water is provided for drinking. Most of the bunkers and support buildings on the PHETS testbeds are hard-wired for power. Heating is provided through refillable propane tanks.

SHIST and Alt. SHIST do not have permanent sources of electricity, heat, or communication.

4.10.3 Transportation and Circulation

PHETS has an extensive internal network of roads both inside test beds and throughout the area. The size, surface, and condition of these roads vary by use. Range Roads 7, 20, and 13 are paved two-lane roads. Others are gravel or dirt. SHIST, and Alt. SHIST are small sites with a single existing access road linking them to the larger range-wide network of roads.

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5.0 ENVIRONMENTAL CONSEQUENCES

5.1 PHYSICAL RESOURCES

5.1.1 Location and Topography

The present boundaries of PHETS and Alt. SHIST will remain unchanged. SHIST Site will be expanded to include an additional 14 ha, extending its boundary lines 250 m north and 150 m east of the present site boundaries.

Several types of ground disturbing activities will take place at PHETS that will alter the topography to varying degrees. Development of two-track roads, placement and removal of temporary target structures, installation of test support infrastructure, and cross-country travel by air sampling vehicles will cause minor changes to microtopography. Construction of a three-story underground parking garage will raise the height of ground level immediately surrounding the structure creating a mound effect. Topography at the PHETS landfill has been previously altered to appear smoother than the surrounding area. Expansion of the landfill will broaden the area of disturbance to include an additional 9 ha and will alter the topography of that area to appear much like the existing landfill.

Ground penetration tests and static explosions will produce cratering at PHETS as well as SHIST and Alt. SHIST. Activities associated with bomb recovery will occur at all three sites and may require extensive use of earth moving equipment.

Mitigation measures will be put in place to minimize the consequences of these actions. Existing roads will be used by vehicles whenever possible. Off-road travel will be limited to placement of testing infrastructure, plume tracking and recovery activities using a single path in and out. New roads will be evaluated and approved by White Sands Environmental Services Division (WS-ES) prior to construction. Following the end of its usefulness as a test structure, the underground parking garage will be demolished and the area returned to its approximate original contour. Impact craters and depressions caused by explosions or recovery activities will be filled and returned to approximate original contour as soon as possible following testing. In cases where recovery activities are prolonged due to extensive data collection efforts, craters and depressions will be filled within two years of testing. Historic craters and depressions will be reclaimed at the project's discretion as time and funding allow.

5.1.2 Aesthetics and Visual Resources

Proposed and on-going actions at PHETS will include construction and explosives testing. Both of these activities will contribute to the disturbed appearance of the landscape. Construction activities will create dust visible to drivers on roads in the PHETS area. New nonpermanent structures, berms, and other infrastructure will also be visible from some local roads.

The greatest visual change will be the expansion of SHIST Site. Penetration tests will create craters and obvious visual ground disturbance noticeable from the access road to

SHIST. Mitigation described in Section 5.1.1, Section 5.2, and Section 5.3 to repair damage to topography and vegetation will over time lessen the visual impact of testing activities. While there will be some additional degradation to the aesthetics of the area these are not significant based on the historic and on-going use of the area.

5.1.3 Climate

Activities at PHETS, SHIST and Alt. SHIST will not alter the climate of the area.

5.1.4 Geology and Soils

Geological resources at PHETS will not be significantly affected from testing activities. HE tests will not significantly affect bedrock formations, which are deeply buried by alluvium. Concrete used for construction activities will have a very minor effect on raw geologic materials such as limestone and sand. At SHIST and Alt. SHIST, projectile impacts into bedrock will affect only very small areas within the individual test beds; these impacts will not affect bedrock resources significantly on any larger scale.

Near-surface soil horizons at PHETS will be disturbed during construction activities; however, these effects will be localized. Explosives tests will disturb near-surface or subsurface soil horizons depending upon explosive magnitude; however the effects will be localized. Other disturbances to near-surface soils will mostly involve vehicles used for plume-tracking and sensor placement. Existing roads will be used to the greatest extent possible to minimize soil disturbance. The relatively steep slope along the mountain front at SHIST (including the expansion area) has potential for accelerated erosion of alluvial soils from ground disturbing activities (e.g., site preparation, projectile recovery). Appropriate erosion control measures will be implemented at the discretion of the WS-ES land manager, to include alternating, angled water bars, terracing, or other erosion control structures.

Simulants and other test materials used in collateral effects tests will settle upon the soil following collateral damage assessments, with the highest concentrations occurring nearest the test structure. The mobility and residence time of these substances in the soil system is governed by physical characteristics such as volatility, degradation rate, and adsorption to soil particles. Table 1 in Appendix B lists test materials used or proposed for use at PHETS, with their physical characteristics. A discussion of expected environmental fate and hazards of simulants and other test materials is contained in Appendix C. Potential soil contamination as a cumulative effect is discussed in section 6.2.1.

5.1.5 Water Resources

Surface Water

No perennial (permanent) water bodies or streams exist in the PHETS, SHIST, and Alt. SHIST areas. Small playa lakes or intermittent streams may form after sufficient rainfall events, but these evaporate or infiltrate rapidly and are short-lived. Construction of new roads and a new test structure at PHETS may potentially modify local surface runoff. Appropriate erosion control measures (e.g., hay bales, water bars, retention ponds) will be used to mitigate effects from new construction. Actions that affect major watercourses or require extensive ground disturbance may require permitting under Section 402 National Pollutant Discharge Elimination System (NPDES) of the Clean Water Act. Section 404 permitting requirements are not applicable to areas other than Salt Creek or Tularosa Creek (David Anderson, WS-ES land manager, pers. comm., 2001), which are areas outside the PHETS, SHIST, and Alt. SHIST regions.

Simulants and other test materials released into the air at PHETS will eventually settle out on the land surface. Most of the material will evaporate, react, or photodegrade rapidly. Under rare conditions, such as a heavy rainfall event immediately after a collateral damage test, part of the remainder may be entrained or dissolved in surface runoff. However, the large surface area of PHETS potentially affected by airborne deposition; losses from evaporation, reactions, and photodegradation; and the infrequency of heavy rains precludes the concentration of substantial amounts of test materials in surface waters.

The warhead impacts and related recovery efforts at SHIST and Alt. SHIST sites will alter the local surface topography within the test beds; however, the affect on broader-scale surface water drainage will not be significant.

Ground Water

Static explosive and air-delivered warhead tests have little potential to affect ground water resources at PHETS, SHIST, and Alt. SHIST. Large ANFO tests of the type conducted in the 1970s and 1980s at PHETS may leave behind leachable materials. However, in areas where the large static detonations have been conducted historically, depth to ground water is over 60 m, and the existing ground water is poor-quality (mostly brackish). Furthermore, the possibility of mixing between ANFO and the existing non-potable ground water is unlikely based upon historic water chemistry data. A major component of ANFO is ammonium nitrate, and nitrogen levels in ground water samples were examined to determine whether ANFO could have potentially been transmitted into the water. A water sample from the DC-1 well, taken in 1983, has a reported dissolved nitrogen concentration (as nitrate and nitrite) of 11 mg/L (USGS, 1985). This sampling pre-dates most of the large ANFO tests done in the area (e.g., DIRECT COURSE, MINOR SCALE, MISTY PICTURE). A sample from a new monitoring well (MW01-3), located very close to the DC-1 well (Fig.5), was sampled for dissolved nitrogen (as nitrate and nitrite) in 2001 and was found to have a concentration of 10.7 mg/L (Table 5). Thus, the almost identical concentrations of nitrogen in the older well, versus the new monitoring well, indicates that ANFO has not affected the ground water at PHETS. Ground water quality at PHETS will be monitored over time through periodic sampling of the three new monitoring wells (see 6.2.2 Potential Ground Water Contamination).

Some of the simulants and other materials from collateral damage tests are potentially leachable; however the ubiquitous caliche horizon in the region and the relatively deep water table make it unlikely that ground water will be significantly affected. The scenario of a large TEP spill was analyzed and was found to have no significant effects upon local ground water (FCDSWA, 1998). Other highly water-soluble compounds such as DMMP, and DPM could potentially migrate to the effective depth of wetting (approximately three to five meters throughout much of PHETS as evidenced by an extensive caliche horizon) but not reach the saturated zone. Characteristics of various test materials in surface and ground water and their expected fates are presented in Table 2, Appendix B and in Appendix C.

Inert, non-explosive projectiles are capable of penetrating the thin alluvial cover to reach bedrock at SHIST and Alt. SHIST. Minor amounts of water are surmised to temporarily accumulate in sediments atop bedrock surfaces, especially during the summer rainy season. Impact and projectile recovery disturbances to this highly localized, transitory ground water will be insignificant.

Burris Well, approximately 1.6 km from Alt. SHIST, will be unaffected by static explosive tests or inert warhead tests.

5.2 BIOLOGICAL RESOURCES

5.2.1 Flora

Ground-based activities will affect vegetation resources inside the PHETS, SHIST, and Alt. SHIST boundaries. Most effects will be spatially limited, and occur in vegetation types that are well represented at the local and regional scale. In many cases, natural succession of colonizing species following the conclusion of tests will prevent permanent vegetation disturbance.

Vegetation within test beds may be impacted by vehicle and foot traffic during test preparations, and by mechanical control of vegetation if required for site maintenance. Mechanical control of vegetation will be restricted to areas within sites where activities will specifically occur in order to maintain ground cover and prevent erosion. Mowing will be the preferred method of site maintenance unless complete removal of vegetation is required.

Ground vehicles will use existing roads when available, and follow a single in-and-out path when traveling off-road. Off-road traffic associated with debris recovery will be restricted in accordance with WSMR Regulation 70-8 (U.S. Department of Army 1981b) to minimize disturbance to the vegetation.

Revegetation of disturbed areas will be evaluated on a case-by-case basis. If required by WS-ES, reseeding will be done using species of indigenous flora approved by the WSMR land manager. Best management practices to minimize erosion hazards will be applied to areas that have inadequate vegetation.

There are three cactus species identified as WSMR species of interest occurring at PHETS and one occurring at SHIST (refer to 5.2.3). These species are not protected under current environmental laws; however, efforts will be made to avoid impact to these species wherever practical. Mitigations may include avoidance, transplantation or other mitigation determined through consultation with WS-ES prior to activities. Under all other circumstances on-site personnel will be instructed not to collect flora.

An extensive list of simulants and taggants proposed for use at PHETS is given in Table 1, Appendix B. There are several ways in which chemical or biological simulants and taggants may affect vegetation in localized areas immediate to test structures (within 100 m). They may affect the uptake of nutrients by plants, which in turn would affect overall plant growth, or they could be toxic to established plants, thereby killing the plants. Finally, they could affect recruitment of new plants by impacting the seed bank. The seed bank is a reservoir of viable seeds in the soil, which will germinate under favorable environmental conditions. Buildup of simulants or taggants in the soil could cause death to seeds in the soil, or could affect the ability of reproducing plants to set large numbers of seeds. Chemical and biological simulants could also affect soil microbial communities (including cryptogamic crusts) which play an important role in plant nutrient uptake, soil binding, and soil water retention. Considering the small areas involved for potential effects, no significant impacts will occur. Table 2, Appendix B and Appendix C describe environmental fates and hazards of the simulants, taggants and other chemicals used at PHETS, including phytotoxicity where known.

Previous use of the chemical simulant triethyl phosphate (TEP) at the PHETS area was projected to cause damage to plants within a 400 m radius of the test structure i.e. plants would turn brown but not die, and plants within 100 m of the test structure might die. It was noted however that following the DIPOLE TIGER and DIPOLE JEWEL tests using TEP, no visual changes were observed in plant communities immediately adjacent to the test structures (FCDSWA, 1998).

WSMR has placed several monitoring transects inside the PHETS boundary concentrated near the Intermediate and Large Test Beds in order to monitor long-term vegetation trends. These data were used to compare vegetation at PHETS to similar vegetation at undisturbed sites ("control" sites). Results of the analysis indicated that individual plant mortality and recruitment of new plants have not been affected by testing at PHETS (refer to Appendix G for a description of the analysis and more in depth discussion of the results). It was not possible to determine from the data available whether plant growth has been affected by testing at PHETS.

Previous tests on WSMR indicate that small numbers of tests using amounts of TEP similar to those proposed in this *PEA* do not appear to have an effect on plant communities. Although thiodiglycol (TDG), and TEP break down relatively slowly when trapped in soil, photodegradation of these test materials is generally rapid. Therefore, surface deposition of simulants from airfall will subject the materials to photodegradation before they can be incorporated into the subsurface. Although in-depth information is not available for each chemical listed, the Tennessee Valley Authority's National Fertilizer and Environmental Research Center studied the phytotoxic effects of TEP and determined that a concentration of 400 mg/m^2 is mildly phytotoxic and concentrations over 40,000 mg/m^2 are potentially fatal to vegetation (Sikora et al., 1994). It is projected that if testing occurred at full capacity using TEP in maximum amounts with no losses, it could reach a concentration of 500 mg/m^2 within five kilometers of the impact site over the next ten years (calculated using TEP surface deposition concentration of 10^{-5} kg/m^2 per test, as projected by FCDSWA, 1998 and adjusted for 4,000 gallons per test). Even with the unrealistic assumption of no losses, this worst-case scenario suggests that levels would only marginally reach the mild phytotoxic range.

Methyl salicylate (MeS), another chemical simulant, produces temporary phytotoxic effects at foliar deposition concentrations of $4x10^{-5}$ kg/m^2 (Cataldo et al., 1993). Although MeS is short-lived in the environment, surface depositions of MeS will likely reach this level near the impact site after a single test, but effects are expected to last only approximately two weeks (Cataldo et al., 1993). Concentrations at which other simulants produce phytotoxicity are not well studied. If phytotoxic effects are identified outside a 400-meter radius and/or fatal effects are seen outside a 100-meter radius around test structures, WS-ES will be consulted and corrective actions will be taken.

Air sampling is done as part of all collateral damage analyses involving simulants and taggants to assess and map the extent and movement of the plume. This information will be used to design a monitoring program that will track the atmospheric concentration and deposition of chemicals, monitor potential build-up of those chemicals in the soil and groundwater, and determine if those chemicals are having an effect on the vegetation, as well as the insect and animal populations in those areas. The results of this monitoring program will be submitted annually to WS-ES. All future tests using simulants will require plume models to be included as part of the U.S. Army Record of Environmental Consideration (REC) coordinated and approved by WS-ES to ensure that they comply with environmental regulations prior to testing.

5.2.2 Fauna

Construction, Penetration Testing, and Recovery Activities

The greatest potential impacts to fauna will be caused by ground disturbance during construction, testing, and recovery activities. While individual mortality may occur, faunal populations will not be significantly impacted. Each activity will affect a limited portion of the total available habitat in the PHETS, SHIST, and Alt. SHIST areas and WSMR as a whole. In most cases testing will be brief and spatially restricted.

During construction activities individuals of smaller, less motile, ground dwelling species, specifically reptiles, amphibians, and invertebrates, may be at risk of direct injury from vehicle traffic, construction machinery, and soil displacement. During these activities, larger more motile species will tend to temporarily vacate areas where the level of human activity is high.

Mitigation will be put into place in order to reduce the impact of construction activities on the faunal populations of PHETS, SHIST, and Alt. SHIST. All open trenches more than approximately 0.5 meter deep that are left open overnight, will have soil or wooden escape ramps (i.e. sticks or boards) placed every 100 m to allow egress of fauna. New electric poles will be designed to meet current raptor protection standards to prevent bird injury or mortality.

Ground penetration testing and recovery activities will cause ground disturbance essentially similar to construction activities. Craters and depressions caused by ground penetration impacts create a risk to animals that might enter the hole and become trapped. The recovery of bombs and missiles from these impacts often involves enlarging the original crater and therefore creates a larger trapping hazard to both large and small faunal species.

Following tests involving ground penetration, all craters will be fenced off to reduce the risk of animals entering craters and becoming trapped or killed. Impact craters and depressions caused by explosions or recovery activities will be filled and returned to approximate original contour as soon as possible. In cases where recovery activities are prolonged due to extensive data collection efforts, craters and depressions will remain fenced and will be filled within two years.

During construction, testing, and recovery, noise from sources such as vehicles, heavy machinery, and general human activity presents a disruption to local fauna. Faunal reactions to noise tend to be species-specific, with individual animals displaying variability in response to noise. Factors influencing faunal responses may be time and length of the noise, seasonality, time of day, stress and physiological effects, life history, naturally occurring and background noise, and habituation (Larkin, 1996).

Most small mammals will avoid excessive noise by retreating into burrows while larger more motile species of mammals and birds will temporarily vacate the area. Reproductive activities of some small mammals and birds may be temporarily disrupted by noise and the presence of humans while other animals may become increasingly habituated and display little modification in behavior with ongoing exposure.

Other potential consequences of testing activities include injury to fauna from flying debris or collision with either aircraft or ordnance. The probability that fauna will be directly hit by debris generated during testing is inherently low. Projectiles impact a small surface area and, in conjunction with the relatively low density of faunal distribution across a large area, this produces a very low probability of directly hitting an individual animal. Likewise, activities will involve only limited aerial activity, which will be deployed for a brief duration and pose little threat of bird collisions.

High Explosive Testing

While there is a risk to fauna from craters and flying debris generated by HE testing, the major consequences to fauna from this type of activity are the effects of airblast and associated overpressure. The range from ground zero (GZ) at which dangerous pressure occurs depends on the size of the explosion. Table 8 shows the distances at which animals may be injured from GZ. These distances represent the probability of serious injury from tumbling across flat terrain. If an animal is protected from tumbling by a burrow or depression, the overpressure required for serious injury increases by forty percent (McMullan and Gould, 1987).

Table 9. Extent of Airblast Damage to Fauna

Effect	Incident Peak Overpressure		Distance from GZ (m) By Test Size		
	kPa	psi	20 Ton	1-KT	8-KT
95% probability of serious injury					
Small animals in the open	103	15.0	82	236	472
50-lb or larger animals in the open	155	22.5	69	198	400
1% probability of serious injury					
Small animals in the open	39	5.7	139	395	762
50-lb or larger animals in the open	52	7.5	122	331	670
Threshold of lung damage					
Small animals	45	6.5	131	363	713
Large animals	85	12.3	86	259	518
Threshold of injury to birds in flight	35	5.0	145	427	853

For large scale events of one kiloton or more the first 200-300 m of terrain around GZ will be graded flat before each detonation. This will discourage most fauna from remaining in the immediate vicinity. Some individual mortality is expected for small mammals and herptofauna that remain in the immediate test area. Craters created by HE testing will be fenced and will remain fenced until the depression can be filled.

There is no danger to bird eggs from airblast outside the immediate vicinity of the test area. Bird eggs are insensitive to overpressure and will not be impacted as a result of HE testing (Evans, 1978).

Collateral Damage Assessments

Potential long-term changes to vegetation communities due to build up of test materials in the soil around test structures and in areas of plume deposition have the potential to "cascade up" the food web to affect other organisms (Hunter & Price, 1990). Table 1, Appendix B lists test materials that have been used or are planned for use at PHETS. The only chemical simulant previously used in large quantities at PHETS is TEP. Studies indicate that this chemical shows low acute toxicity in animals, with an oral LD_{50} of 1500 mg/kg body weight and 1600 mg/kg body weight for mice and rats, repsectively.

Empirical results from previous tests using TEP project a low surface deposition concentration of 10^{-5} kg/m^2 for a single test. It is difficult to predict the amount of TEP that will be ingested by rodents and other animals near PHETS based on known TEP surface depositions. It is likely that the amount of TEP required to produce toxic effects on animals is above the minimum of 400 mg/m^2, the level at which toxic effects on plants may first be observed. Evidence of phytotoxicity will trigger mitigation described in Section 5.2.1 and prevent an adverse impact on animal populations.

All other chemical simulants are also of low acute toxicity to animals (refer to Appendix C), and no short-term effects of chemcial simulants on animals are expected. There is limited information on chronic faunal toxicity of proposed simulants due to the relatively short lifespan of wildlife species. Animal populations near PHETS will be monitored as a part of the mitigation described in Section 5.2.1.

Bacillus thuringiensis (Bt), a common bacterium occurring in soils worldwide, is proposed for use as a biological simulant at PHETS. Bt is commercially produced as an insecticide which targets moths, beetles, and flies (Tomlin, 1994). Although Bt does not have the potential to buildup in the environment, it could impact populations of insects near the test site. This would affect the supply of food for insectivorous fauna immediate to the test structure. However, recolonization of these areas by affected insect species is expected after testing ceases.

Other test materials, such as the tracers and taggants, are generally not hazardous to animals. Some have been used in previous tests at WSMR and are discussed in the NEPA documents outlined in Section 1.2. Appendix C details the environmental fate and hazards of tracers and taggants proposed for use at WSMR and outlines potential effects of those materials on plants.

Collateral damage assessments may also result in noise and flying debris similar to effects described for construction and penetration testing. General mitigation to protect fauna and habitat includes the use of existing roads by vehicles whenever possible. Off-road travel will be limited to placement of testing infrastructure, plume tracking and recovery activities using a single path in and out. Personnel will be instructed not to harm, harass, or collect fauna.

5.2.3 Threatened, Endangered, or Sensitive Species

Flora

No currently listed Federal or State endangered, threatened, or sensitive (TES) plant species are known or expected to occur at PHETS, SHIST or Alt. SHIST. Four floral species listed as WSMR species of interest (SOIs) were identified as potentially occurring at one or more sites. Three species, grama grass cactus, pineapple cactus, and daggerthorn cholla, have been previously identified at PHETS. Plant surveys conducted for this *PEA* confirm the presence of daggerthorn cholla at PHETS. No pineapple or grama grass cactus were found during survey efforts. Daggerthorn cholla was also found at SHIST Site. The fourth species, cory jointfir was not found at SHIST or Alt SHIST. These species have no legal protection under Federal or State law, however, the WSMR land manager will be notified prior to disturbance of natural vegetation communities to determine if any remedies, such as transplantation, are available to lessen impact to these species.

Todsen's pennyroyal is the only Federal endangered plant species known to occur on WSMR. Three populations of this species exist in the Chalk Hills area of WSMR, some 40 km southwest of PHETS. Although there is a potential for chemical simulant plumes to travel 30 km or more, prevailing winds on WSMR are more likely to carry the plume to the northeast, away from these plant populations, making it unlikely that these chemicals will come in contact with this species. Plume movement predictions and actual test results from the DIPOLE ORBIT and DIPOLE JEWEL series demonstrate direction of travel predominately to the east-northeast (Unpublished test data from DIPOLE ORBIT and DIPOLE JEWEL, 2001).

Fauna

Birds. Grassland communities below 1,800 m at PHETS have been identified as potential aplomado falcon habitat (STEWS-NRES, 1997). Correspondence between the USFWS and WSMR outlines protocols that will be followed for surveys of aplomado falcons and the steps that will be initiated if one is sighted on WSMR (Appendix F). The aplomado falcon is State and federally listed as an endangered species. Surveys have been conducted for this species on an annual basis since 1996 (D. Holdermann pers. comm. 2002). Failure to detect individuals during formal surveys indicates that WSMR does not currently support a resident population. If an aplomado falcon sighting is reported, testing activities will be suspended while WS-ES consults with USFWS to determine further action. If these protocols are followed, aplomado falcons will not be adversely affected by the proposed activities.

Potential habitat for the aplomado falcon will be affected but not adversely impacted by the proposed activities. Most ground-based activities will occur within established test beds. While some of the grassland communities at PHETS do occur within these test beds and may be impacted by test activities, the affected area and degree of impact will be small in comparison to the overall amount of habitat available to the aplomado falcon both within PHETS and on WSMR as a whole. WSMR protocol will ensure the Fire Department is on standby during each test, minimizing the possible loss of desert grassland habitats by wildfires accidentally ignited from impacts. Conservation policies concerning debris-ignited wildfires in aplomado falcon habitat will be considered in further detail in the WSMR Fire Management Plan currently being prepared (D. Holdermann pers. comm. 2000), and recommendations will be adopted as part of this *PEA*.

Sparsely vegetated, open areas associated with disturbance like those found at PHETS, SHIST, and Alt. SHIST are ideal habitat for the burrowing owl, a WSMR species of interest. Burrowing owls typically live in abandoned rodent burrows. During the breeding season, January through October, project personnel will observe areas prior to ground disturbing activities for the presence of burrowing owls specifically looking in areas that show evidence of rodent burrows. If a burrowing owl is detected, WS-ES will be notified and mitigation will be developed to ensure there is no significant impact.

The loggerhead shrike, another WSMR species of interest, occurs as a year-round resident at PHETS, SHIST, and Alt. SHIST. The loggerhead shrike prefers shrubby areas for perching, foraging, and nesting. This vegetation type is widely distributed throughout PHETS, at SHIST, and Alt. SHIST and vicinity, and across WSMR. Although individuals may temporarily vacate areas adjacent to test and construction areas, the widely dispersed population of loggerhead shrikes on WSMR will not be adversely affected.

The other bird species listed in section 4.2.3 may occur only as seasonal or migrant transients. Two species, Lucifer's hummingbird and the violet-crowned hummingbird have not been identified on WSMR; however, SHIST and Alt. SHIST are in proximity to suitable habitat. Based on habitat preference the gray vireo could reside at one or more of the test sites, however none were found during biological surveys. If any of the species listed in Table 6, Section 4.2.3 are found following the completion of this *PEA*, WS-ES will be consulted to determine if additional mitigation is necessary to prevent impact to listed avian populations.

Mammals. The desert bighorn sheep has the potential to inhabit the vicinity of Alt. SHIST. A single radio-collared animal inhabits a range that includes the Alt. SHIST area. If this animal is seen in proximity to the site prior to a test, WS-ES will be contacted prior to testing.

Black-tailed prairie dogs, a Federal candidate species, may have had a historical presence at PHETS. Possible burrows were observed in a 1994 survey; however, burrows were not detected in recent survey efforts targeting their presence, making it unlikely that they currently inhabit the PHETS area. If prairie dogs are observed during ground disturbing activities at PHETS, WS-ES will be contacted to determine further action.

The spotted bat is a State threatened species that may potentially use the PHETS, SHIST, and Alt. SHIST sites as foraging habitat. In addition, roosting habitat may occur in proximity to SHIST Site. The presence of ground disturbing activities in foraging habitat will have no effect on this species because most test activities will take place during roosting hours. Bats roosting in the SHIST area will either relocate as a result of disturbance or become habituated to the activity at this site. The use of chemical and biological simulants may affect the insect population of the PHETS area thereby affecting the food source for the spotted bat and other insectivorous fauna within a 5 km radius of the test beds. This effect will be scrutinized as part of a long-term monitoring program described in section 5.2.2, however, the reduction of food base in the a local area is not significant compared to the available food base elsewhere on WSMR.

The Oscura Mountain Colorado chipmunk, another State-listed threatened species, has been found in areas approximately 8 km north of SHIST Site. Sightings of this species are rare, and it is not expected to inhabit the SHIST Site or be affected by test activities in that area.

Fish. The White Sands pupfish is an endangered fish species occurring in four locations on WSMR: Mound Springs, Malpais Springs, Salt Creek, and Malone Draw/Lost River. The nearest population is in Salt Creek approximately 18 km south of PHETS. It is unlikely that simulants and other test materials will affect this species because prevailing winds move toward the northeast away from Salt Creek. Tests employing simulants will occur only under ideal meteorological conditions with wind speed less than 20 knots at ground level from the south-southwest. The likelihood that simulant plumes would reach Salt Creek is also decreased by the presence of a drainage divide at Mockingbird Gap separating the two areas. Toxicity of simulants to fish is generally low, although toxicity of phosphonate compounds is unknown (refer to Appendix C). In the unlikely event that simulants are carried over pupfish habitat, anticipated simulant deposition will be low. Previous air dispersal models have evaluated the use of TEP as a simulant inside a structure. The results of this analysis suggested that tests as large as 2.75 million gal. could be performed in this manner without damage to the White Sands pupfish (FCDSWA, 1998). The amount of TEP or other simulants allowed under this *PEA* is 15,142 L (4000 gal) per test.

5.3 CULTURAL RESOURCES

Proposed actions at PHETS, SHIST, and Alt. SHIST that include weapons testing and related support and recovery efforts, have the potential to disturb or destroy archaeological resources. General mitigation for protection of cultural resources include the use of existing roads whenever possible. Off-road vehicle travel will be limited to placement of test infrastructure, plume tracking and recovery activities using a single path in and out and avoiding all known archaeological sites. WS-ES will be consulted to determine the most appropriate route for off-road travel associated with construction or recovery activities. Archaeological surveys to identify cultural resources will be conducted as necessary prior to ground disturbing activities in previously unsurveyed areas. Project personnel will not disturb existing archaeological sites or any other historic or prehistoric cultural materials. Site-specific mitigation measures addressing the proposed actions are summarized below.

5.3.1 PHETS

As part of an overall Historic Preservation Plan, there is a Memorandum of Understanding between the New Mexico Preservation Division and the Department of the Army at White Sands Missile Range regarding Trinity Site Protection and Land-use Management. This agreement establishes “a Limited Compatible Use Zone”(LCLU) in which PHETS test activities can take place under certain stipulations (Eidenbach, 1988). These stipulations specify that all new structures placed within the National Historic Landmark will be temporary, and that all temporary structures, berms, and other non-historic, test related infrastructure will be removed “after completion of the action requiring their construction, unless written agreement has been reached between WSMR and the SHPO to approve their retention, or if the modifications are found to enhance the Trinity Landmark Site.”

Previous tests at PHETS have demonstrated the vulnerability of McDonald Ranch House to high explosive (HE) testing. Therefore, the house will be examined before and after each HE test event greater than 20 tons. Explosion size will be limited to 8 KT or less and overpressures will be limited to 5.5 kPa or less, and for all tests expected to exceed 2 kPa overpressure, the ranch house will be braced. For all 20-ton HE tests the windows of the house will be removed. For events from 1 KT up to 8 KT roof beams will be braced and windows removed. For 8-KT tests, roof beams will be braced, windows will be removed, and openings will be closed to prevent over pressures from entering the house; adobe walls on the south and west side will also be braced. These mitigations mirror those originally proposed in the PHETS EA of 1987. Airblast will have no effect on ceramic or lithic artifacts (McMullan and Gould, 1987).

The proposed landfill expansion has been surveyed for cultural resources. No archaeological sites were recorded; however, there are several nearby. The expanded landfill boundary will be fenced, and all land disturbing activities will occur within those fenced boundaries.

5.3.2 SHIST

The proposed expansion area for SHIST will be surveyed for cultural resources. Any resources found within the area will need to be evaluated according to Section 106 and in consultation with the State Historic Preservation Office (SHPO).

5.3.3 Alternate SHIST

There are no mitigations specific to the Alt SHIST site, however all general mitigations above apply.

5.4 PRESENT LAND USE

5.4.1 Military

The proposed actions at PHETS, SHIST, and Alt. SHIST are consistent with the mission of WSMR and current testing activities taking place at these locations. The majority of ground disturbance will be limited to test beds at PHETS and within site boundaries of SHIST and Alt. SHIST. The proposed landfill expansion in the Large Test Bed at PHETS will convert approximately 9 ha adjacent to the existing landfill and cable yard from a natural to a disturbed state. Additional temporary structures and test support infrastructure may be placed at PHETS. The expansion of SHIST will convert approximately 14 ha from a natural state into military land use. These changes will not alter the existing character of the sites and will therefore have no significant effect on land use.

5.4.2 Recreation

There will be no conflict between recreational activities and proposed activities at PHETS, SHIST and Alt. SHIST. Most testing activities will take place during regular duty hours, when recreational activities are not permitted. Trinity Site tours occur the first Saturday of April and October. Hunting is allowed on WSMR only on a non-interference basis during weekends, holidays, and Range non-duty days. In the event that testing activities must be conducted during non-duty hours, Range Scheduling and WS-ES will be notified in advance to ensure that no conflicts occur.

5.4.3 Airspace

The frequency of flights per year for PHETS, SHIST, and Alt. SHIST test activities will remain essentially unchanged. Flights have been taking place at or near these levels for several years with no effect. Careful scheduling will continue to prevent conflicts with other programs.

5.5 AIR QUALITY

Potential program impacts to air quality are primarily attributed to discharge from the concrete batch plant, dust from construction and recovery activities, simulant testing, generators, and vehicles. The effect on air quality will depend on various mechanical factors such as fuel type and generator size, and on various dispersion factors such as altitude, atmospheric mixing characteristics, and wind speed. Dissipation of exhaust emissions and airborne particulates is enhanced by weather conditions typically experienced throughout WSMR. WS-ES personnel, to determine permit requirements, will evaluate all generators brought onto WSMR. All other emissions will be of short duration and infrequent, occurring only during recovery and construction activities and will not have a significant effect on the environment.

PHETS has been listed as an area targeted for specific dust control measures as part of the WSMR Particulate Matter Control Report (U.S. Army, 2001), which is currently being developed. The Natural Events Action Plan (NEAP) for Dona Ana County (NMED, Air Quality Bureau, 2000) to control dust generation is to be formally approved by the EPA in the near future. WSMR is an active stakeholder in this effort. Although the NEAP is county-specific, activities occurring on WSMR that do not fall within Dona Ana County are nevertheless required to comply with the NEAP (U.S. Army, 2001). PHETS activities will comply with the NEAP and will follow reasonable suggestions that do not interfere with the mission of WSMR.

Test preparations involving mechanical blading, or vehicles traveling along unpaved roads, could cause a temporary increase in airborne soil particulate matter. A dust suppressant will be applied when practical to minimize excessive vehicle-generated dust levels, and vegetation cover will be retained on sites whenever possible. Penetration impacts will create transitory dust plumes in localized areas. However, dust released into the air from these temporary and intermittent sources will be a relatively minor component compared to natural dust storms that occur across the region.

Large scale HE events, 1 KT or larger, have the potential to loft large amounts of dust that not only affect air quality but also have the potential to obscure photographic coverage of the event and cause damage to sensitive experiments and instrumentation. For a period of two weeks beginning approximately four weeks prior to each test a dust suppressant will be applied in areas around ground zero. Explosive by-products of ANFO and similar explosives will be lofted into the atmosphere, however, 97% (by weight) of these by-products consist of water, nitrogen, and carbon dioxide. The remaining 3% of compounds occur in small insignificant quantities. Dust suppressant use will be documented in mission-specific RECs and coordinated with WS-ES-EC.

Chemical simulant plumes, comprised of a cloud of aerosol droplets, will be released into the air during collateral damage assessments. Plumes will dissipate rapidly to very low deposition concentration. In previous tests using TEP, surface deposition crossing the nothern WSMR boundary was less than 10^{-5}kg/m^2 (DTRA, 1999). It is surmised that dispersion of other simulants will result in similar low deposition concentrations at the WSMR boundary. Some of the biological simulant plumes will contain bacterial spores.

In DIPOLE ORBIT, concentration of viable spores in the plume at the WSMR boundary was between 10 and 100 CFU at a single point. It is estimated that in proposed testing, concentration of spores in the plume at the WSMR boundary will be comparable to concentrations used in aerial agricultural application (see Appendix C for discussion).

Plume tracers and taggants are inert gases and rare earth oxides. The tracer gases sulfur hexafluoride and carbon tetrafluoride are green house gases, and the EPA monitors emissions of these gases. At maximum proposed testing, contributions of these gases to total global concentrations will be insignificant (see Appendix C for discussion). The rare earth oxides are powders, with permissible exposure limit (PEL) values between 3 and 5 mg/m^3. The taggant dysprosium oxide was previously used at WSMR in the DIPOLE ORBIT 3 test, where concentration in the plume was 0.01 mg/m^3 at the WSMR boundary (Unpublished test data from DIPOLE ORBIT, 2001), well below estalished PEL values.

5.6 NOISE AND BLAST

Noise sources associated with program activities include those related to test preparations, detonation of penetration weapons and static high explosive charges, impacts of large debris, aircraft, and ground vehicles. Construction will sporadically increase noise levels, but will not be heard in areas accessible to the public. Audible noise from a test will be infrequent and of short duration. Larger mammals and birds in the vicinity will most likely respond to these noises by temporarily leaving the area.

The effects of noise and blast from HE testing vary with charge size. Hearing protection will be provided to any exposed personnel within 9200 m of an event 1 KT or larger. For 20-ton events, personnel will be expected to wear hearing protection at the administration area and other areas where noise levels are expected to exceed 140 dB. Temporary and possibly permanent hearing loss is expected in some animals within 3 km radius of ground zero for an 8 KT test. Overpressure effects are discussed for fauna and cultural resources in sections 5.2.2 and 5.3.

5.7 RADIATION

Proposed program activities present no significant impacts from ionizing or nonionizing sources of radiation. Activities involving sources of radiation will comply with rules and regulations outlined by the U.S. Nuclear Regulatory Commission and the Army Radiation Safety Program (Army Regulation 11-9 [1999]).

Sources of ionizing radiation in program activities include instrumentation fielded for large-scale testing and the testing of chemical agent detectors. These instruments may emit low-level alpha-radiation which poses little health hazard. Sources of non-ionizing radiation include laser guidance and tracking systems, site illumination, communication, and optical counter measures. The potential for spectral electromagnetic interference from systems will be analyzed on a project specific basis. A power intensity of 10 mW/cm^2 or greater is generally nominated as the threshold for hazardous human exposure. Personnel will comply with safety procedures involving support equipment. Safety zones will be established and clearly delineated to exclude entry from hazardous radiation.

5.8 HAZARDOUS WASTE

Only emergency maintenance of vehicles and equipment will be conducted on-site during construction, minimizing the production of hazardous waste compounds (e.g., petroleum, oil and lubricants or POL products). Removal of all solid waste, trash, hardware, debris, etc., will be the responsibility of the program. Any hazardous waste generated by construction or test activities will be recovered and disposed according to WSMR Hazardous Waste Management Plan. Program activities will not place a significant demand on hazardous waste facilities at WSMR, which are governed by WSMR Regulation 200-1.

5.9 HUMAN HEALTH AND SAFETY

General health and safety protocols for WSMR personnel are addressed in various Federal, State, and WSMR guidelines, rules and regulations. Examples include establishment of roadblocks, evacuations, personnel clear zones, and use of hearing protection prior to tests. Two comprehensive programs addressing these issues are Army Regulation 385-100 and WSMR Regulation 385-18. Detailed standard operating procedures (SOPs) have been established to fulfill health and safety requirements. WSMR is a participant in the Emergency Operations Plan, which establishes a response network involving Federal, State, and local agencies.

Personnel handling and contact with chem/bio test materials will occur mainly during test preparations, and post-test evaluation and site clean-up. Concentrated test materials are generally eye, skin, and respiratory irritants. Personal protection equipment (PPE) will be used in accordance with MSDS recommendations by all personnel handling any of the test materials listed in Appendix B.

As a result of collateral damage testing, it is likely that some amount of simulant will travel beyond the WSMR boundary. In past tests the amount of TEP crossing the WSMR boundary is several orders of magnitude less than the lowest lethal concentration for inhalation of that chemical by rats (LCLo = 28,000 ppm after 6 hr. exposure). There is no OSHA personal exposure limit for TEP and it is not expected to be a health concern for people or livestock based on the minimal exposure expected to result from test activities.

Concentrations of biological simulants in the plume at the WSMR boundary are likely to be equivalent to those used in agriculture. Other chemical simulants are likely to have dispersion characteristics similar to TEP and are not expected to cross the WSMR boundary in significant concentrations (see Appendix C).

WSMR policy requires that personnel receive unexploded ordnance (UXO) training, directing employees to remain within approved areas and not to handle unfamiliar objects. Unfamiliar objects believed to be UXO will be reported to WSMR Range Control.

Most program activities will be conducted in frequently used facilities, reducing the risk of exposure to hantavirus following contact with rodent urine and droppings. Personnel will avoid areas that may be a potential hantavirus risk until that risk has been evaluated and abated if necessary.

5.10 SOCIOECONOMICS AND INFRASTRUCTURE

5.10.1 Economy

Programs may include military personnel, civil servants, and contractors, many of whom reside in the local area. Project activities provide small but relatively long-term socioeconomic benefits from increased regional employment, primarily for Socorro, New Mexico, where many personnel live. The proposed level of activity evaluated in this *PEA* does not substantially differ from current tests, so changes in the economic impact to local businesses and surrounding communities will be minor.

5.10.2 Utilities

The current and future demand on WSMR utilities by activities at PHETS, SHIST, and Alt. SHIST is within existing capacity. Where hard-wired power supplies are not available, activities will rely on portable generators for power. Generators will be inspected to ensure proper working order and compliance with applicable permitting requirements for safety, air quality, and spill containment.

Raptors, through collision, entanglement or electrocution in power and communication lines, may potentially interrupt services. New electric poles will be designed to meet current raptor protection standards, to prevent bird injury or mortality and to safeguard infrastructure and services.

Water and septic system use is expected to increase with the improvements to the PHETS Administrative Park. There will be a need for water to be trucked down from Stallion Range Center on a more frequent basis but the increased water usage will be within the existing capacity of the Stallion well system. The septic system will be expanded at the PHETS Administrative Park to handle any expected increase in septic waste.

Proposed activities will not significantly affect natural gas demand or supplies on WSMR. Communication requirements will be accommodated by existing capabilities of the WSMR network.

5.10.3 Transportation and Circulation

The road network at WSMR has the capacity to accommodate existing traffic patterns. No significant impact is expected as a result of the proposed actions due to the fact that they represent an extension of on-going test activities. There will be no significant increase in trip generation to or from the three sites. Current access to PHETS, SHIST, and Alt. SHIST is presently adequate to support expected use. During testing, roadblocks on U.S. Highway 380 and internal WSMR routes will temporarily disrupt normal traffic flow. This is a normal occurrence and will not have a significant impact.

5.11 ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVES TO PROPOSED ACTIONS

Selection of an alternative testing facility outside of WSMR will generally decrease potential environmental effects at PHETS, SHIST, and Alt. SHIST. With testing moved elsewhere and assuming no re-occupation by a subsequent tenant, the landscape at these sites will revert toward a pre-disturbance condition over time, although this will probably never entirely be attained again on a human time scale. Land use for the sites will continue to be designated for military testing, but these sites will be used less intensively as current testing activities are phased out and moved to the new testing area. Improvements will occur regarding visual appearance, soil, topography, water resources, biological resources, air quality, and noise. In addition, the burden on utilities, air space, and transportation infrastructure will be slightly reduced. However, the socioeconomic environment will be negatively affected with fewer testing personnel employed, the loss of PHETS, SHIST, and Alt. SHIST as a testing area for other projects, and less contractor and business activity. Geology, climate, and cultural resources will remain essentially unaffected.

An additional alternative is to develop new test beds within WSMR for bedrock penetrations tests requiring suitable granite exposures. This alternative pertains only to SHIST and Alt. SHIST and does not alter the current or proposed use of PHETS. Construction and testing at previously undeveloped sites will have impacts on visual appearance, topography, geology, natural habitat, water resources, and possibly other environmental components similar to those seen at SHIST and Alt. SHIST. Depending upon the location(s), additional access roads may be constructed adding to the amount of habitat loss resulting from site construction and potentially increasing the amount of windblown dust produced by WSMR. This alternative would increase the total amount of disturbed land on WSMR. The socioeconomic environment will remain essentially unchanged in regard to WSMR, entailing simply a geographic shift of human and non-human resources.

The no action alternative will allow present testing activities to continue at PHETS, SHIST, and Alt. SHIST until expiration of current environmental documents. Physical, biological, and cultural resources will also be subject to cumulative effects related to continued testing at the three areas, and are likely to be similar to cumulative effects discussed for the proposed action, but to a lesser degree. The no action alternative will not include environmental monitoring and other new mitigations specified for the proposed action.

6.0 CUMULATIVE IMPACTS

6.1 REGIONAL SETTING

Overview

Cumulative impacts result from the incremental impact of actions on the environment over past, present, and reasonably foreseeable future timeframes. These effects are additive and are often generated from several sources in combination. Several facilities (in addition to PHETS, SHIST, and Alt. SHIST) produce effects that contribute to the overall environment of the northern part of White Sands Missile Range (WSMR) and are discussed individually in this section.

Each of these facilities has existing National Environmental Policy Act (NEPA) documentation covering its operation. This operation may include localized land disturbance and associated effects to the environment that are discussed and mitigated inside these documents. There are also effects including noise, emissions, and air and vehicle traffic that are transitory events which do not significantly contribute cumulative effects to the region.

The Aerial Cable Range (ACR) is located approximately 11 km east of PHETS. ACR was constructed in 1992 and, as the name implies, is a 49,200 m cable with a mobile target-carrying trolley suspended between two mountains. The ACR EIS (PSL, 1991) specifies that it may be used for up to 400 missions per year. An estimated 20 percent would involve a missile firing operation from a ground-based launcher. The remaining 80 percent of tests involve items dropped from a trolley simulating airborne delivery systems for ordnance and other materials.

The Large Blast/Thermal Simulator (LB/TS) is located approximately nine miles northwest of PHETS. The facility is a large scale shock tube constructed in 1990 to test military systems against nuclear blast and thermal environments. It was originally estimated to host 100-150 tests per year. The duration of each test is normally expected to be between one and a half and five hours per test. It is currently in stand-by mode or caretaker status. There is no current testing taking place at this facility to add to the current level of environmental impact in the North Range area.

There are two weapons impact target areas (WITs) located within 8 km of the PHETS area. Stallion WIT and 649 WIT are part of the 90-Mile Impact Area which also includes the Northeast Center Impact area (NECI) approximately 16 km (10 mi) north of PHETS. With the exception of NECI which is not currently in use, these impact areas are in constant can be used for air-to-surface or surface-to-surface test missions. NECI and Stallion WITs are Phase II impact areas used to test live submunitions. The 649 WIT is a Phase I impact area used to test non-lethal submunitions.

6.2 PHETS, SHIST, AND ALTERNATE SHIST

Current testing activities at PHETS, SHIST, and Alt. SHIST are covered under previous NEPA documents and U.S. Army Records of Environmental Consideration (RECs). This

Programmatic Environmental Assessment *(PEA)* places all current and foreseeable activities at these three locations under one document and discusses the individual and cumulative effects of the different types of testing being conducted. All high explosive (HE) testing, collateral damage assessments, and counter-terrorism testing will be conducted at PHETS. Penetration testing will take place at PHETS, SHIST, and Alt. SHIST. Table 10 is a summary of maximum annual testing for all three sites.

Table 10. Maximum annual testing allowed under this PEA

Type of Test	PHETS	SHIST	Alt. SHIST
High Explosive Testing			
1000 lb	10	10	10
100 lb	6	10	10
2500 lb	10	NA	NA
20 ton	4	NA	NA
1 KT to 8 KT	1	NA	NA
Collateral Damage Assessment			
Use of Simulants - Chemical	4	NA	NA
Use of Simulants - Biological	4	NA	NA
Penetration Testing			
Live	15	10	3
Inert	30	30	30
Counter-terrorism Testing			
	10	NA	NA

(NA) = Not Allowed

The following sections consider the cumulative effects of past and future testing on the physical, biological, and cultural resources of the PHETS, SHIST and Alt. SHIST areas specifically.

6.2.1 Potential Soil Contamination

The long testing history at PHETS has created the opportunity for potential accumulation of unburned explosives, explosive residues, and chem/bio test materials in the soil. Potential explosive-related contamination is a greater concern regarding ground water and is discussed in section 6.2.2.

Environmental effects of tests using triethyl phosphate (TEP), the most extensively used simulant thus far, have been previously analyzed and included mitigation measures to limit the release of this compound into the environment (FCDSWA, 1998). These measures, however, focused on immediate post-test monitoring and cleanup and did not include adequate provisions for detecting accumulation of test-related materials over time. TEP does not readily degrade in the soil system and has the potential for accumulation. A scenario has been calculated assuming 1893 L is expelled in each test, at maximum annual testing frequency, with deposition on the soil surface and no subsequent losses. The amount used in this calculation is five times greater than the actual dispersed amount from a previous test (378 L) (FCDSWA, 1998) but may be reasonable in anticipation of future open-pad simulant testing at PHETS. Potential TEP concentration on the soil surface may reach approximately 500 mg/m^2 within a 5-km radius of the test structure over a ten-year period (calculated using TEP surface deposition concentration of 10^{-5} kg/m^2 per test, as projected by FCDSWA, 1998). Although this concentration is hypothetical, it is used for establishing TEP testing limits on the basis of phytotoxicity levels (refer to section 5.2.1 Flora).

Other chemical simulants have varying persistence in the soil system. DMMP, has an average half-life in soil of 12.4 days and also has high potential for leaching (Howard et al., 1986).

Under this *PEA*, potential accumulation of unburned explosives, residues, and test materials in the soil will be evaluated through surface and subsurface (approximately 25-30 cm) sampling at locations near LTS-1, Above-Ground Test Structures 1, 2, and 3, and LTS-2. Sampling will be conducted once a year in conjunction with ground water sampling (refer to Section 6.2.2). Collected samples will be analyzed using a certified analytical laboratory. Any measurable concentration of such substances will be evaluated for significance and, if found to approach thresholds based on LD_{50}/LC_{50}, phytotoxicity, or other pertinent criteria, appropriate mitigation measures will be implemented. If, after two full years of sampling following the last test using either simulants, high explosives or other test related materials, no significant accumulations of these materials are detected, soil sampling and analysis will be discontinued.

Only inert penetrating warheads have been used at SHIST and Alt. SHIST. The thin, rocky soils at these test beds have not been exposed to significant quantities of unburned explosives, explosive residues, or any chem/bio test materials.

6.2.2 Potential Ground Water Contamination

High explosive testing (especially the large ANFO blasts) at PHETS has provided a potential means for ground water contamination from unburned explosives, explosive residues and by-products. In addition to the ammonium nitrate and fuel oil that comprises the ANFO charge, an 8-KT-equivalent test, for example, yields a variety of detonation products including carbon monoxide 91,526 kg, nitrogen dioxide 1403 kg, nitrous oxide 575 kg, and hydrogen cyanide 235 kg (McMullan and Gould, 1987). These substances are undesirable in ground water, but would dissipate rapidly after a test and not reach to the depth of water–bearing sediments. See Section 5.1.5 Groundwater discussion of well water sampling results regarding ANFO.

The more mobile, leachable chem/bio simulants (e.g., TEP, DMMP) (refer to Table 2, Appendix B, Appendix C, and section 6.2.1 above) have the potential for accumulating in the ground water at PHETS. This occurrence is unlikely considering the relatively deep water table, the presence of a widespread caliche or gypsic horizon, and the lack of rainfall in the region.

Potential accumulation of unburned explosives, residues, and test materials in the ground water will be evaluated through periodic sampling of three monitoring wells (MW00-1, MW00-2, and MW01-3). Sampling will be conducted once per year in conjunction with soil sampling (refer to Section 6.2.1). Collected samples will be analyzed using a certified analytical laboratory. Any measurable concentration of such substances will be evaluated for significance and, if found to approach Environmental Protection Agency (EPA) water quality standards or other pertinent criteria, appropriate mitigation measures will be implemented. If, after two full years of sampling following the last test using either simulants, high explosives or other test related materials, no significant accumulations of these materials are detected; ground water sampling and analysis will be discontinued.

Inert projectile testing at SHIST and Alt. SHIST poses little potential for cumulative contamination of the ground water and thus has no significant impact on this resource.

6.2.3 Potential Effects on Biological Resources

In 1988, White Sands Missile Range (WSMR) implemented the Integrated Training Area Management (ITAM) Program for the purpose of coordinating natural resource management with training and testing activities occurring on WSMR (AR 350-4). One component of ITAM is long term monitoring of biological resources using Land Condition Trend Analysis (LCTA) data collection plots. Initially 200 "core" plots were established in order to assess changes in plant and animal communities over time. Later additional "special use" plots were established in order to address more specific questions that core plots might not be able to address. Special use plots located at PHETS provide information that can be used to assess cumulative impacts on biological resources at that site. Although these data were not consistently collected or analyzed over time, useful information can still be extracted (Houde-Nethers, pers comm., 2001).

As discussed in section 5.2.1 and 6.2.1, there is a potential for buildup of chemical simulants at PHETS due to repeated testing. It is known that high levels of the chemical simulant TEP affect vegetation (Sikora et al., 1994). In order to determine if previous testing at PHETS has affected vegetation, LCTA data were analyzed. Comparison of vegetation at PHETS to similar vegetation at undisturbed sites ("control" sites) indicates that individual plant mortality and recruitment of new plants has not been negatively affected by testing at PHETS (refer to Appendix G for a description of the analysis and more in depth discussion of the results). It was not possible to determine whether plant growth has been affected by testing at PHETS because data that could address this question were not available.

Due to the potential buildup of simulants in the soil and because interactions among these compounds or by-products of breakdown are not well documented, a monitoring program will be put in place. Existing LCTA plots are clustered at the Intermediate and Large Test Beds, and are not adequate to monitor the concentration of simulants and related materials being deposited from explosion plumes. New vegetation monitoring plots will be randomly placed within a 5 km radius of the test beds, in areas most heavily impacted by chem/bio test materials (FCDSWA, 1998). An equal number of control plots will be established in areas of similar vegetation and soil type near PHETS, but in areas not affected by testing. Control plots will provide baseline data against which to compare data collected at the PHETS plots. Within each plot, perennial vegetation will be measured both for growth rate and recruitment/death rates. Presence/absence surveys for mammals, herpetofauna and birds will be conducted. In addition, soil samples and possibly plant or animal samples taken from each plot will be measured for chemical simulant concentration. Monitoring in these plots will take place once annually.

Proposed tests may employ any of the simulants and other chemicals listed in Appendix B in substantial quantities, in various combinations, and using various delivery mechanisms. Information from various sources including past test data, published articles, conference proceedings, and Material Safety Data Sheets (MSDSs) have been compiled in Appendices B and C. A discussion of the effects of simulants and plume tracers and taggants is contained in Appendix C. The monitoring program proposed above will be designed to detect any bioconcentration of chemicals in the food web. If chem/bio test materials are detected as part of the monitoring program outside a 400-meter radius around test structures, WS-ES will be notified to determine a course of action. As a result of build-up, one or more chemicals may be eliminated from the list in Appendix B at the discretion of WS-ES.

There are no LCTA data plots located near the SHIST or Alt. SHIST sites. Following the mitigations outlined in Sections 5.1.1 and 5.2.1 it is not expected that there will be cumulative impacts on plants or animals associated with the small scale high explosive or penetration testing at either SHIST or Alt. SHIST sites.

6.2.4 Potential Effects to Cultural Resources

Undiscovered cultural features may exist at PHETS. These features may potentially be disturbed from off-road vehicle travel during plume tracking. These events would be unanticipated singular events that would not result in cumulative effects. All other activities including off-road travel will require advance approval from WS-ES archaeologists. Mitigations specified in Section 5.3 will prevent disturbance to archaeologically significant areas.

The most historically important structure in the vicinity of PHETS is the McDonald Ranch House, located just east of the PHETS boundary. McDonald Ranch House is listed on the National Register of Historic Places and is part of the Trinity National Historic Landmark. In the past, large scale HE tests has caused damage to the structure. The Trinity nuclear detonation blew out the windows, but the structure remained intact.

Since McDonald Ranch House is considered such a valuable cultural resource, a structural analysis of the ranch house was done in 1980 prior to MILL RACE, a one KT test, and in 1983 prior to MINOR SCALE, an eight KT HE test. Two additional structural analyses were done before and after MISTY PICTURE, another eight KT test conducted in 1987. These analyses concluded that if specific measures were taken to protect the structure it would safely weather airblasts from explosions up to eight KT. These protective measures have been adopted as part of this *PEA* and are explained in Sections 5.3 and 9.3 of this document. With these mitigations in place, the MINOR SCALE and MISTY PICTURE tests did cause minor cosmetic damage to McDonald Ranch House including cracked plaster and damage to cellulose ceiling boards, which was later repaired. In 1984 the house was restored by the National Park Service and is being restored to look similar to the way it looked just prior to the Trinity explosion on July 12, 1945.

Future HE tests will be limited to 8 KT or less. As in the past, airblast from this type of test may cause minor cosmetic damage to the structure. If this occurs the damage will be repaired and no cumulative effects are expected.

6.2.5 Potential Effects to WSMR Facilities

Some of the activities at PHETS include high explosive, projectile penetration, and counter-terrorism tests designed to defeat hardened targets. These hardened targets are structures designed and built to simulate real world structures. They are continually damaged or destroyed by on going test activities. After each test, damaged structures are repaired to accommodate the next test series. In the event that a particular structure sustains cumulative damage or is damaged in a single event beyond repair, the building will be demolished and may or may not be rebuilt at the tenant's discretion.

Buildings in the Administration Park at PHETS and other WSMR structures at nearby sites such as Millers Watch and Queen 16 are also vulnerable to window breakage and other damage from overpressures associated with large-scale high explosive (HE) tests of one kiloton (KT) or more. These structures are vacated during HE tests and are inspected before being reoccupied. Any damage sustained by these buildings is repaired and no cumulative effects are expected.

There are no permanent structures on or near SHIST and Alt. SHIST that will be affected by testing activities at those locations.

7.0 ENVIRONMENTAL JUSTICE

Activities at PHETS, SHIST, and Alt. SHIST will be conducted in a manner that will not substantially affect human health or the environment. The analysis has identified no effects that will result in disproportionately high or adverse effects on minority or low income populations in the area. This program will recognize obligations under Title VII and other Federal regulations to prevent discrimination on the basis of race, religion, sex, national origin, or handicap.

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8.0 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

The proposed action will result in no permanent loss of habitat for plants or animals. It will result in the disturbance of 9 ha of previously undisturbed land to accommodate the expansion of the PHETS landfill. An additional 14 ha of previously undisturbed land will be incorporated into the SHIST Site resulting in a temporary change in vegetative characteristics and distribution of animal species at both locations.

Based on the resource-protective measures for listed species within the PEA and/or White Sands Missile Range survey protocols, these species are not likely to be adversely affected and no loss of cultural resources is anticipated. If the potential for irreversible or irretrievable commitment of biological or cultural resources becomes evident during construction or testing, activities will be halted until the White Sands Environmental Services Division can be consulted.

The amount of materials and energy required to support program-related activities, although relatively small, is unavoidable. The initiation and/or continuation of the activities described in this *PEA* will result in the irreversible and irretrievable commitment of resources such as various metallic materials, fuel, chemicals, explosive components, construction materials used in targets, and labor.

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9.0 SUMMARY OF MITIGATION

The following sections of the Programmatic Environmental Assessment (*PEA*) summarize mitigation measures that tenants of the PHETS, SHIST, and Alt. SHIST sites must adopt in order to perform the proposed actions with no significant impact to the environment. Changes to environmental conditions (e.g., threatened or endangered status of resident flora or fauna) will result in a reevaluation of the proposed actions. Additional documentation will be required if the scope of proposed actions described in this *PEA* is expanded, if additional types of testing are desired, or if impacts are significantly greater than anticipated in this analysis.

9.1 PHYSICAL RESOURCES

- Existing roads will be used by vehicles whenever possible.

- Off-road travel will be limited to placement of testing infrastructure, plume tracking and recovery activities using a single path in and out.

- New roads will be evaluated and approved by WS-ES prior to construction.

- Following the end of its usefulness as a test structure, the underground parking garage will be demolished and the area returned to its approximate original contour.

- Impact craters and depressions caused by explosions or recovery activities will be filled and returned to approximate original contour as soon as possible following testing.

- In cases where recovery activities are prolonged due to extensive data collection efforts craters and depressions will be filled within two years of testing.

- Historic craters and depressions will be reclaimed at the project's discretion as time and funding allow.

- Appropriate erosion control measures will be implemented at the discretion of the WS-ES land manager, to include alternating, angled water bars, terracing, hay bales, retention ponds, or other erosion control structures.

- Permits will be attained prior to commencement of actions requiring approval under National Pollutant Discharge Elimination (NPDES) or Section 404 of the Clean Water Act.

- A dust suppressant will be applied to minimize excessive dust levels on new construction areas, roads and to testing areas as necessary.

9.2 BIOLOGICAL RESOURCES

- Mechanical control of vegetation will be restricted to areas within sites where activities will specifically occur in order to maintain ground cover and prevent erosion. Mowing will be the preferred method of site maintenance unless complete removal of vegetation is required.

- Ground vehicles will use existing roads when available. Off-road travel will be limited to placement of testing infrastructure, plume tracking and recovery activities using a single path in and out. Off-road traffic associated with debris recovery will be restricted in accordance with WSMR Regulation 70-8 (U.S. Department of Army 1981b) to minimize disturbance to flora, fauna, and habitat.

- Revegetation of disturbed areas will be evaluated on a case-by-case basis. If required by WS-ES, reseeding will be done using approved species of indigenous flora. Best management practices to minimize erosion hazards will be applied to areas that have inadequate vegetation.

- There are several cactus species identified as WSMR species of interest occurring at PHETS and one occurring at SHIST (refer to 5.2.3). These species are not protected under Federal or State law; however, efforts will be made to avoid impact to these species wherever practical. Mitigations may include avoidance, transplantation or other mitigation determined through consultation with WS-ES prior to activities. Under all other circumstances on-site personnel will be instructed not to collect flora.

- All open trenches more than approximately 0.5 meter deep that are left open overnight, will have soil or wooden ramps placed every 100 m to allow egress of fauna.

- Following tests involving ground penetration or static high explosive charges, all craters will be fenced off to reduce the risk of animals entering craters and becoming trapped or killed. Impact craters and depressions caused by explosions or recovery activities will be filled and returned to approximate original contour as soon as possible. In cases where recovery activities are prolonged due to extensive data collection efforts craters and depressions will remain fenced and will be filled within two years of testing.

- For large scale events of one kiloton or more the first 200-300 meters of terrain around ground zero will be graded flat before each detonation. This will discourage most fauna from remaining in the immediate vicinity.

- If an aplomado falcon sighting is reported, testing activities will be suspended while WS-ES consults with USFWS to determine further action.

- New electric poles will be designed to meet current raptor protection standards, to prevent bird injury or mortality.

- WSMR protocol will ensure the Fire Department is on standby during each test, minimizing the possible loss of desert grassland habitats by wildfires accidentally ignited from impacts. Conservation policies concerning debris-ignited wildfires in aplomado falcon habitat will be considered in further detail in the WSMR Fire Management Plan currently being prepared (D. Holdermann pers. comm. 2000), and recommendations will be adopted as part of this *PEA*.

- Bare open areas associated with disturbance like those found at PHETS, SHIST, and Alt. SHIST are ideal habitat for the burrowing owl, a WSMR Species of Interest. During the breeding season, January through October, project personnel will observe areas prior to ground disturbing activities for the presence of burrowing owls specifically looking in open areas that show evidence of rodent burrows. If a burrowing owl is detected, WS-ES will be notified and mitigation will be developed to ensure there is no significant impact.

- If any of the bird species listed in Table 6, Section 4.2.3 are found following the completion of this *PEA*, WS-ES will be consulted to determine if additional mitigation is necessary to prevent impact to listed avian populations.

- If prairie dogs are observed during ground disturbing activities at PHETS, WS-ES will be contacted to determine further action.

- The desert bighorn sheep has the potential to be seen in the vicinity of Alt. SHIST. A single radio-collared animal inhabits a range that includes the Alt. SHIST area. If this animal is seen in proximity to the site prior to a test WS-ES will be contacted.

- Air sampling data will be used to help design a monitoring program that will track the atmospheric concentration and deposition of chemicals, monitor potential build-up of those chemicals in the soil and groundwater, and determine if those chemicals are having an effect on the vegetation, as well as the insect and animal populations in those areas.

- Tests employing simulants will occur only under ideal meteorological conditions with wind speed less than 20 knots at ground level and prevailing wind traveling in a direction other than south-southeast.

- A monitoring program will be implemented to detect concentration of test materials in the environment. If concentration of chemicals is seen in soil, water, plant, seed, or insect populations outside a 400 meter radius around test structures, use of those chemicals will halt until further analysis can be completed. As a result of build-up one or more chemicals may be eliminated from the list in Appendix B at the discretion of WS-ES. The results of this monitoring program will be submitted annually to WS-ES.

- All future tests using simulants will require plume models to be included as part of the U.S. Army Record of Environmental Consideration (REC) sent to WS-ES prior to testing.

- Personnel will be instructed not to harm, harass, or collect flora or fauna.

9.3 CULTURAL RESOURCES

- Project personnel will not disturb existing archaeological sites or any other historic or prehistoric cultural materials.

- All ground disturbing activities must be coordinated with WS-ES archaeologists to insure the preservation of cultural resources in the project areas.

- Existing roads will be used whenever possible. Off-road vehicle travel will be limited to placement of test infrastructure, plume tracking and recovery activities using a single path in and out. WS-ES will be consulted to determine the most appropriate route for off-road travel associated with construction or recovery activities.

- Archaeological surveys to identify cultural resources will be conducted as necessary at the discretion of WS-ES archaeologists.

PHETS

- McDonald Ranch House will be monitored before and after each large scale event over 20 tons.

- Over pressures will be limited to 5.5 kPa or less and the McDonald Ranch House will be braced for tests expected to exceed 2 kPa overpressure.

- For all 20 ton HE tests the windows of the house will be removed. For events from 1 KT up to 8 KT roof beams will be braced and windows removed. For 8 KT tests roof beams will be braced, windows will be removed, and openings will be closed to prevent over pressures from entering the house. Adobe walls on the south and west side will be braced. The maximum limit for HE tests is 8 KT.

- The proposed landfill expansion has been surveyed for cultural resources. No archaeological sites were recorded; however, there are several nearby. The expanded landfill boundary will be fenced, and all land disturbing activities must remain within those fenced boundaries.

- The proposed expansion area for SHIST Site must be surveyed for cultural resources. Any resources found within the area will need to be evaluated according to Section 106 and in consultation with the State Historic Preservation Office (SHPO).

9.4 PRESENT LAND USE

- In the event that testing activities must be conducted during non-duty hours, Range Scheduling and WS-ES will be notified in advance to ensure that no conflicts occur between testing and recreational activities. Careful scheduling will also prevent conflicts with other programs regarding road closures and the use of air space.

9.5 AIR QUALITY

- All generators brought onto WSMR will be evaluated by WS-ES personnel to determine permit requirements.

- A dust suppressant, such as water, will be applied to roads and construction areas when practical to minimize excessive vehicle-generated dust levels.

- Large scale HE events, 1 KT or larger, have the potential to loft large amounts of dust that not only affect air quality but also has the potential to obscure photographic coverage of the event and cause damage to sensitive experiments and instrumentation. For a period of two weeks beginning approximately four weeks prior to each test a dust suppressant will be applied in areas around ground zero. Magnesium chloride, for example, may be applied in a 25 percent solution as necessary to control dust.

9.6 NOISE AND BLAST

- Hearing protection will be provided to any exposed personnel within 9200 m of an event 1 KT or larger. For 20 ton events, personnel will be expected to wear hearing protection at the Administration area and other areas where noise levels are expected to exceed 140 dB.

9.7 RADIATION

- Personnel will comply with safety procedures involving support equipment. Safety zones will be established and clearly delineated to exclude entry from hazardous radiation.

9.8 HAZARDOUS AND TOXIC MATERIALS/WASTES

- Only emergency maintenance of vehicles and equipment will be conducted on-site during construction, minimizing the production of hazardous waste compounds (e.g., petroleum, oil and lubricants or POL products).

- Removal of all solid waste, trash, hardware, debris, etc., will be the responsibility of the program.

- Any hazardous waste generated by construction or test activities will be recovered and disposed according to the WSMR Hazardous Waste Management Plan.

- The contractor will dispose of refuse from portable on-site latrines.

9.9 HUMAN HEALTH AND SAFETY

- Evacuations and roadblocks will be ordered prior to each test to protect WSMR employees and the public.

- All personnel will receive unexploded ordnance (UXO) training, directing employees to remain within approved areas and not to handle unfamiliar objects. Unfamiliar objects believed to be UXO will be reported to WSMR Range Control.

- Personal protection equipment (PPE) will be used in accordance with MSDS recommendations by all personnel handling TEP or any test material listed in Appendix B.

- Prior to use, an assessment of simulants other than TEP will be completed to predict plume concentrations and potential health effects beyond WSMR boundaries. If this analysis indicates the potential for human health risk test parameters will be adjusted.

- Personnel will avoid areas that may be a potential hantavirus risk until that risk has been evaluated and abated if necessary.

9.10 SOCIOECONOMICS AND INFRASTRUCTURE

- Generators will be inspected to ensure proper working order and compliance with applicable permitting requirements for safety and air quality.

- Raptor protection devices will be installed on new electric poles associated with program activities to safeguard birds and infrastructure services.

9.11 CUMULATIVE IMPACTS

- Under this *PEA*, potential accumulation of unburned explosives, residues, and test materials in the soil will be evaluated through surface and subsurface (approximately 25-30 cm) sampling at locations near LTS-1, Above-Ground Test Structures 1, 2, and 3, and LTS-2. Sampling will be conducted once per year in conjunction with ground water sampling (refer to Section 6.2.2). Collected samples will be analyzed using a certified analytical laboratory. Any measurable concentration of such substances will be evaluated for significance and, if found to approach thresholds based on LD_{50}/LC_{50}, phytotoxicity, or other pertinent criteria, appropriate mitigation measures will be implemented. If, after two full years of sampling following the last test using either simulants, high explosives or other test related materials, no significant accumulations of these materials are detected, soil sampling and analysis will be discontinued.

- Potential accumulation of unburned explosives, residues, and test materials in the ground water will be evaluated through periodic sampling of three monitoring wells (MW00-1, MW00-2, and MW01-3). Sampling will be conducted once per year in conjunction with soil sampling (refer to Section 6.2.1). Collected samples will be analyzed using a certified analytical laboratory. Any measurable concentration of such substances will be evaluated for significance and, if found to approach Environmental Protection Agency (EPA) water quality standards or other pertinent criteria, appropriate mitigation measures will be implemented. If, after two full years of sampling following the last test using either simulants, high explosives or other test related materials, no significant accumulations of these materials are detected; ground water sampling and analysis will be discontinued.

- Due to the potential buildup of simulants in the soil, and because interactions among these compounds or by-products of breakdown are not well documented, a monitoring program will be put in place. Existing LCTA plots are clustered at the Intermediate and Large Test Beds, and are not adequate to monitor the concentration of simulants and related materials being deposited from explosion plumes. New vegetation monitoring plots will be randomly placed within a 5 km radius of the test beds, in areas most heavily impacted by chem/bio test materials (FCDSWA, 1998). An equal number of control plots will be established near PHETS, but in areas not affected by testing. Control plots will provide baseline data against which to compare data collected at the PHETS plots. Within each plot, perennial vegetation will be measured both for growth rate and recruitment/death rates. Presence/absence surveys for mammals, herptofauna and birds will be conducted. Plants or animals may be sampled for bioconcentration of chemicals.

- After each test, damaged structures are repaired to accommodate the next test series. In the event that a particular structure sustains cumulative damage or is damaged in a single event beyond repair, the building will be demolished and may or may not be rebuilt at the tenant's discretion.

- Buildings in the Administration Park at PHETS and other WSMR structures at nearby sites such as Millers Watch and Queen 16 are also vulnerable to window breakage and other damage from overpressures associated with large-scale high explosive (HE) tests of one kiloton (KT) or more. These structures are vacated during HE tests and are inspected before being reoccupied.

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10.0 CONCLUSIONS

This Programmatic Environmental Assessment (*PEA*) describes proposed actions taking place at the PHETS, SHIST and Alt. SHIST sites. These actions have been evaluated to identify potential environmental impacts and the severity of those impacts. Mitigation measures have been proposed to reduce or eliminate any significant impact associated with the use of these sites for the types and number of tests specified. There are no significant impacts that could not be mitigated.

Therefore, a Finding of No Significant Impact (FNSI) on the environment had been concluded. The FNSI is included at the front of this *PEA*. Accordingly, the U.S. Army and White Sands Missile Range have determined that an Environmental Impact Statement pursuant to the National Environmental Policy Act is not required for the proposed actions described by this *PEA*.

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ABBREVIATIONS AND ACRONYMS

ABL	Airborne Laser
ACR	Aerial Cable Range
AGM	air-ground guided missile
Alt. SHIST	Alternate Seismic Hardrock In Situ Test
ANFO	ammonium nitrate - fuel oil
APAM	anti-personnel anti materiel
AQCR	Air Quality Control Region
AR	Army Regulation
ATL	Advanced Tactical Laser
BC	before Christ
BLU	bomb live unit
Bg	*Bacillus subtilis*
Bt	*Bacillus thuringiensis*
C-4	Composition 4
CA	California
chem/bio	chemical/biological
CO	carbon monoxide
COIL	chemical oxygen iodine laser
CTS-1	Counter-terrorism Structure #1
DES	Directorate of Environmental Safety
DMMP	dimethyl methyl phosphate
DPM	dowanol glycol ether
DTRA	Defense Threat Reduction Agency
EA	environmental assessment
EIS	environmental impact statement
FCDSWA	Field Command, Defense Special Weapons Agency
FNSI	finding of no significant impact
GBR	Ground Based Radar
GBU	guided bomb unit
GZ	ground zero
HE	high explosive
HMX	cyclotetramethylenetetranitramine
HSR	Human Systems Research
ITAM	Integrated Training Area Management
JASSM	Joint Air-to-Surface Standoff Missile
JDAMS	Joint Direct Attack Munitions
LADAR	laser-radar combination
LIDAR	Light Detecting and Ranging
LB/TS	Large Blast/Thermal Simulator
LC_{50}	lethal concentration at which 50% of test subjects die
LCLo	lowest published lethal concentration
LCTA	Land Condition Trend Analysis
LD_{50}	lethal dose at which 50% of test subjects die
LIDAR	light detecting and ranging
MBRS	Mobile Ballistic Research System

MeS	methyl salicylate
MSDS	material safety data sheet
MW	monitoring well
NAAQS	National Ambient Air Quality Standards
NECI	Northeast Center Impact area
NEPA	National Environmental Policy Act
NHL	National Historic Landmark
NM	Nitromethane or New Mexico (based on context)
NMAQB	New Mexico (NM) Air Quality Bureau
NMDGF	New Mexico Department of Game and Fish
NMED	New Mexico Environment Department
NMNHP	New Mexico Natural Heritage Project
NMSU	New Mexico State University
NO_2	nitrogen dioxide
NPDES	National Pollutant Discharge Elimination System
NTS	Nevada Test Site
NV	Nevada
O_3	ozone
OSHA	Occupational Safety and Health Administration
PEA	programmatic environmental assessment
PETN	pentaerythritol tetrantirate
PHETS	Permanent High Explosive Test Site
PM_{10}	respirable particulate matter
PEL	permissible exposure limit
POL	petroleum, oil, and lubricants
PPE	personal protection equipment
PSL	Physical Science Laboratory
RDX	cyclotrimethylenetrinitramine
REC	Record of Environmental Consideration
RR	range road
SHIST	Seismic Hardrock In Situ Test
SHPO	State Historic Preservation Office
SO_2	sulfur dioxide
SOC	species of concern
SOI	species of interest
SOP	standard operating procedure
sp	one species
spp	multiple species
TACMS	Tactical Missile Systems
TEP	triethyl phosphate
TES	threatened, endangered, sensitive
TNT	trinitrotoluene
U.S.	United States
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
UT	Utah
UXO	unexploded ordnance

WIT	Weapons Impact Target area
WMD	weapons of mass destruction
WS-ES	White Sands Environmental Services Division
WSMR	White Sands Missile Range
WSNM	White Sands National Monument

UNITS OF MEASURE

^{o}C	degrees Celsius
cm	centimeter
dBA	decibel
ha	hectare
kg	kilogram
km	kilometer
kPa	kilopascal
kph	kilometers per hour
KT	kiloton
KVA	kilovolt-ampere
L	liter
m	meter
mg	milligram
Mg	megagram
mg/kg	milligram per kilogram
mg/L	milligram per liter
mg/m^2	milligram per square meter
mg/m^3	milligram per cubic meter
MW	megawatt
MW/cm^2	megawatt per square centimeter
ppb	parts per billion
ppm/ppb	parts per million per parts per billion
psi	pounds per square inch

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APPENDIX A.
Test History of PHETS, SHIST, and Alternate SHIST

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DATE	TEST NAME	TEST TYPE	LOCATION
PHETS			
06 Oct 1976	DICE THROW	Static HE test, 628 tons ANFO	DTA (PHETS)
16 Sep 1981	MILL RACE	Static HE test, 600 tons ANFO	LTB
07 Oct 1982	Pre-DIRECT COURSE	Static HE test, 24 tons ANFO	LTB
26 Oct 1983	DIRECT COURSE	Static HE test, 609 tons ANFO	LTB
28 Nov 1984	MINI SCALE l	Static HE test, 22.8 tons ANFO	LTB
28 Feb 1985	MINI SCALE ll	Static HE test, 22.6 tons ANFO	LTB
27 Jun 1985	MINOR SCALE	Static HE test, 4774 tons ANFO	LTB
14 May 1987	MISTY PICTURE	Static HE test, 4685 tons ANFO	LTB
10 Aug 1988 24 Aug 1988 17 Nov 1988	MISTY PORT l, 2, & 3	Static HE tests, 1000 lbs. Pentolite (l & 2); 1000 lbs. Nitromethane (3)	PTB
01 Jun 1989	MISERS GOLD	Static HE test, 2445 lbs. ANFO	LTB
24 Aug 1989 01 Nov 1989	MIDNIGHT HOUR 1 & 2	Static HE tests, 1000 lbs. nitromethane	PTB
16 Feb 1990 04 Apr 1990 24 Apr 1990	MINERAL FIND 1, 2, & 3	Static HE tests, 1000 lbs. HMX	PTB
17 May 1990 26 Apr 1990 14 Jun 1990 28 Jun 1990	DIPOLE BLADE 1, 2, 3, & 4	Static HE tests, 122 mm rocket and MK 83 bombs	ITB
23 Aug 1990 01 Nov 1990	MINERAL FIND 4 & 5	Static HE tests, 534 lbs. HEST, 672 lbs. BLEST, 166 lbs. Center charge (total)	PTB (MF 4) ITB (MF 5)
14 Nov 1990	DILUTE EXPLOSIVE TILE (DET) TEST	Static HE test, 154.7 lbs. DET/HEST	PTB
20 Feb 1991 30 Apr 1991 14 Aug 1991 10 Oct 1991	HURRICANE LAMP 1, 2, 3, & 4	Static HE tests, 1000 lbs. HMX	PTB
22 Feb 1991 14 Feb 1991	DIPOLE CHAIN 4 & 5	Static HE tests,68.2 kg TNT (DC 4); 7 kg C-4 (DC 5)	PHETS

DATE	TEST NAME	TEST TYPE	LOCATION
12 Apr 1991 02 May 1991 15 May 1991 12 Jul 1991	DIPOLE CHAIN 2, 3, 6, & 7	Static HE tests, MK 83 bomb (DC2); 1000 kg fuel-air explosive (FAE) and 9 kg C-4	ITB (DC 2)
20 Jun 1991	DISTANT IMAGE	Static HE test, 2440 lbs. ANFO	LTB
18 Sept 1991	MINERAL FIND 6	Static HE test, 855.5 lbs. DET/DETASHEET	ITB
Nov 1991	BAR GAGE DEVELOPMENT TEST		PHETS
17 Jul 1991 05 Dec 1991 30 Jan 1992	MIDDLE KEY 1, 2, & 3	Static Static HE tests, 1000 lbs. ATX-25R-M	PTB
07 Feb 1992 29 Apr 1992 30 Sept 1992	DISTANT MOUNTAIN 1, 2, & 3	Static HE tests, 16.54 tons nitromethane (each test)	LTB
06 May 1992 29 Apr 1992	DIPOLE FAÇADE 1 & 2	Static HE tests, 150 lbs. TNT (DF 1); 15.4 lbs. C-4 (DF 2)	PHETS
24 Jun 1992 26 Jun 1992 01 Jul 1992 09 Jul 1992	DIPOLE DATE 5-8	Static HE tests, 0.4 lbs. C-4 each test	PHETS
06 Aug 1992	HUSKY JAGUAR 1	Static HE test, 1010 lbs. nitromethane	PTB
08, 09, 10, 11, Sept 1992	DIPOLE DATE 9-16	Projectile penetration tests, Sandia Air Gun	PHETS
10 Sept 1992	HURRICANE PEAK 1	Static HE test, DET-HEST/nitromethane (1368 lbs./1500 lbs.)	ITB
22, 23 Sept 1992	DIPOLE DATE 17 & 18	Projectile penetration tests, Davis Gun	PHETS
15, 21, 27, 29 Oct 1992	DIPOLE DATE 1-4	Static HE tests, 23 lbs. C-4 (total of 4 tests)	LTB
04, 18, 24 Feb 1993 30 Mar 1993 28 Apr 1993 05 May 1993	DIPOLE EAST 9-14	Static HE tests, 3.2 lbs. C-4 (DE 9-12 total); 39.6 lbs. Tritonal (DE 13 & 14)	PHETS
18 Mar 1993 25 Mar 1993	DIPOLE FAÇADE 3 & 4	Static HE tests, 150 lbs. TNT (DF 3); 15.4 lbs. C-4 (DF 4)	PHETS
10 Jun 1993	MINOR UNCLE	Static HE test, 2431 tons ANFO	LTB
29 Jul 1993	HUSKY JAGUAR 2	Static HE test, 1011.5 lbs. Nitromethane	PTB

DATE	TEST NAME	TEST TYPE	LOCATION
05 Aug 1993	DIPOLE EAST 19	Projectile penetration test, Davis Gun	ITB
13 Aug 1993	DIPOLE EAST 20	Static HE test, 546 lbs. QM-100RA	ITB
03 Sep 1993	DIPOLE EAST 2	Aircraft-delivered, live I-800	LTB
17 Sep 1993	MIDDLE KEY 4	Static HE test, 22.7 tons QM-100R	ITB
09 Dec 1993 29 Sep 1993	DIPOLE EAST 30 & 31	Aircraft-delivered penetration tests, three inert GBU-28s (total of both tests)	LTB
18 Nov 1993	DIPOLE EAST 25	Aircraft-delivered, two GBU-24s	LTB
09 Dec 1993 15 Dec 1993	DIPOLE EAST 15 & 16	Static HE tests, 65 lbs. C-4	LTB (LTS-1)
12, 19, 21, 25, 27 Jan 1994	DIPOLE EAST 1, 26-29	Projectile penetration tests, Davis Gun	LTB (LTS-1)
02 Mar 1994 30 Mar 1994 04 May 1994	DIPOLE EAST 22, 21, & 51	Static HE test, 1656 lbs. QM-100RA (total of 3 tests)	LTB (LTS-1)
03, 09 Jun 1994	DIPOLE EAST 24A & 24B	Aircraft-delivered, 546 lbs. Tritonal in GBU-27s	LTB (LTS-1)
16 Jun 1994 22 Jun 1994	DIPOLE FAÇADE 6 & 5	Static HE test, 310 lbs. TNT (total both tests)	ITB
15 Jul 1994 11 Aug 1994	DIPOLE EAST 32 & 33	Aircraft-delivered penetration test, inert GBU-28s	LTB (AF-1)
13, 16 Sep 1994	BOLTS 1-3	Aircraft-delivered penetration tests, six inert GBU-27/B (total of tests)	LTB (LTS-1)
15 Sep 1994	MIGHTY NORTH 1	Test of limestone structure, DET/IREMITE 42	PTB
19 Oct 1994 09 Nov 1994	DIPOLE EAST 34 & 35	Aircraft-delivered penetration test, inert GBU-28s	LTB (AF-2)
29 Nov 1994	DIPOLE EAST 36	Aircraft-delivered penetration test, live GBU-28	LTB
01 Feb 1995	DIPOLE EAST 37	Aircraft-delivered penetration test, live GBU-27	LTB (AF-2)
23 Jun 1995	DIPOLE IDLE 2	Counter proliferation test, 5 MK 23 JATO rockets	LTB (LTS-1)
22 Aug 1995	DIPOLE MIGHT 9	Car bomb test, 1000 lbs. ANFO in van	LTB
04 Oct 1995	DIPOLE EAST 154 &	Aircraft-delivered inert	LTB (LTS-1)

DATE	TEST NAME	TEST TYPE	LOCATION
26 Oct 1995	155	GBU-27/B, fuse and penetration test	
03 Dec 1995	DIPOLE ORBIT 1	Static HE test, BLU-109 (Tritonal)	LTB (DO-1 structure)
11 Dec 1995	DIPOLE ORBIT 2	Aircraft-delivered penetration test, live GBU-24 (failed to detonate)	LTB (DO-2 structure)
08 Feb 1996	DIPOLE EAST 158	Aircraft-delivered penetration test, one live, one inert GBU-27/Bs (Tritonal)	LTB (AF-3)
09 Apr 1996	DIPOLE ORBIT 4	Aircraft-delivered penetration test, live GBU-24 (failed to detonate)	LTB (DO-2 structure)
11 Jun 1996	DIPOLE ORBIT 5	Static HE test, BLU-109	LTB (DO-2 structure)
20 Jul 1996	DIPOLE EAST 159	Static HE test, 64 lbs. TNT	LTB (AF-1)
10 Oct 1996	DIPOLE EAST 158C	Static HE test, 575 lbs. QM-100RA, BLU-109/B	LTB (AF-3)
10 Dec 1996	DIPOLE ORBIT 3	Aircraft-delivered collateral effects test, GBU-24	LTB (DO-3 structure)
06 Mar 1997	DIPOLE EAST 157	Aircraft-delivered smart fuse test, live GBU-27/B	LTB (LTS-1)
17 Apr 1997 15 May 1997	DIPOLE TIGER 1 & 2	Static (1) and air-delivered (2) HE tests for TEP dispersion and collateral effects	LTB (AGTS-1)
15 Jun 1997	EOD Simulation Experiment	Static (5) collateral effects of Desert Storm EOD procedures	LTB
12 Nov 1997	DIPOLE MIGHT 21 & 23	Truck bomb tests, 30,000 lbs. C-4 (total of 2 tests)	LTB
29 Jan 1998 25 Mar 1998	DIPOLE JEWEL 1 & 2	Aircraft-delivered collateral effects test, two live GBU-24s each test	ITB (LTS-2)
11 Jun 1998	DIPOLE JEWEL 4	Aircraft-delivered collateral effects test, live GBU-24	ITB (LTS-2)
17 Jun 1998	DIVINE BUFFALO 2	Counter-terrorism test, 0.77 lbs. C-4	ITB (CTS-1)
07, 09, 14, 16, 17 Jul 1998	DIVINE GLADIATOR 1/1A, 2, 3, 4, & 5	Static HE tests using C-4, 6671.3 lbs. (total of all tests)	ITB
23 Jul 1998	DIPOLE XERIC	Projectile bounce test, inert BLU-109 using Davis Gun	LTB (AF-1)

DATE	TEST NAME	TEST TYPE	LOCATION
14 Aug 1998	DIVINE BUFFALO 5	Structural response test, 100 lbs. C-4	ITB (near CTS-1)
24 Aug 1998	DIPOLE EAST 161	Aircraft-delivered penetration test, 2 inert GBU-27s	LTB (AF-2)
01 Sep 1998 02 Oct 1998 28 Oct 1998	DIPOLE JEWEL 7, 3, & 5	Aircraft-delivered penetration test, 1 live GBU-27 (DJ 7); 2 live drops (DJ 3); 1 live drop (DJ 5)	ITB (LTS-2)
23 Sep 1998	DIVINE BUFFALO 1	Counter-terrorism test, 5000 lbs. C-4	ITB (CTS-1)
20 Oct 1998 17 Nov 1998	DIPOLE MIGHT 15 & 22	Truck bomb test using ANFO, 5,000 lbs. (DM 15); 20,000 lbs. (DM 22)	LTB (?)
03 Dec 1998	DIPOLE SAMSON 8	Static HE test of BLU-116	ITB (LTS-2)
25 Feb 1999 28 Apr 1999	DIVINE BUFFALO 9 & 6	Counter-terrorism tests using C-4, 5000 lbs. (DB 9); 1000 lbs. (DB 6)	ITB (CTS-1)
23 Sep 1999	DIPOLE EAST 169	Static HE test of warhead for collateral effects	ITB
27 Sep 1999	DIPOLE EAST 160	Aircraft-delivered penetration test, 4 live GBU-27s	LTB (AF-3)
21 Oct 1999	DIVINE BUFFALO 19	Counter-terrorism test, 300 lbs. C-4	ITB (CTS-1)
26 Oct 1999	DIPOLE MIGHT 30	Truck bomb test, 10,000 lbs. ANFO	LTB
08 Nov 1999	DIVINE ALBATROSS 5 & 6	Penetration tests in concrete using Sandia Air Gun, inert 1/3-scale BLU-109s	PTB
09 Dec 1999	DIVINE BUFFALO 8	Counter-terrorism test, 1000 lbs. C-4	ITB (CTS-1)
15 Dec 1999	DIVINE ALBATROSS 7	Static HE test, 181 lbs. QM-100RAT	PTB
18-21 Jan 2000	DIVINE ALBATROSS 8-15	Penetration tests in damaged concrete using Sandia Air Gun, inert 1/3-scale BLU-109s	PTB
27 Jan 2000	DIVINE BUFFALO 7	Counter-terrorism test, 1000 lbs. C-4	ITB (CTS-1)
24 May 2000	DIVINE BUFFALO 4	Counter-terrorism test, 1560 lbs. C-4	ITB (CTS-1)
SHIST Site			
28 Apr 1998	DIPOLE LIGHT 10	Aircraft-delivered inert	SHIST

DATE	TEST NAME	TEST TYPE	LOCATION
		BLU-109s in JDAMs to test accuracy and penetration	
07 May 1998 29 May 1998	DIPOLE SAMSON 7 & 8	Aircraft-delivered penetration test in granite, 1 live, 1 inert GBU-27s (DS 7); 2 live (DS 8)	SHIST
27 Jul 1998	DIPOLE SAMSON 31	Penetration tests in granite using Davis Gun, inert BLU-109	SHIST
28 Oct 1999	DIPOLE LIGHT 12	Static HE test in granite, 540 lbs. QM-100 RAT in BLU-109	SHIST
11 Apr 2000 13 Apr 2000 05, 07, 08 Jun 2000	DIVINE THUNDERBOLT 1-11	Aircraft-delivered penetration test in granite, inert GBU-28s (DT 9 & 10 landed outside of test beds)	SHIST
Alternate SHIST Site			
16 Aug 1995	BMTD	STORM MTTV granite penetration test	Alt. SHIST
25-27 Jul 1997; 24-26, 28-29 Aug 1997	DIPOLE SAMSON 3, 4, & 5; 6, 9, 10, 11, & 12	Inert projectile penetration tests in granite using the Mobile Ballistic Research System (MBRS)	Alt. SHIST
16 Dec 1997 18 Dec 1997	DIPOLE SAMSON 1 & 2	Penetration tests in granite using Davis Gun, inert BLU-109	Alt. SHIST
06-08 Jan 1998	DIPOLE SAMSON 17-22	Penetration tests in granite using Sandia Air Gun, inert 1/3-scale BLU-109s	Alt. SHIST
26 Aug 1998 28 Aug 1998	DIPOLE SAMSON 30 & 29	Penetration tests in granite using Davis Gun, inert ¾-scale BLU-113	Alt. SHIST
24 Sep 1998	MTD-3	Missile penetration test in granite	Alt. SHIST
28-31 Oct 1998 02-05 Nov 1998	DIPOLE SAMSON 13-16, 23, 24, 25, 26, & 27	Penetration tests in granite, warhead simulation penetrators	Alt. SHIST

ABBREVIATIONS and ACRONYMS

AF-1	Air Force Test Structure #1
AF-2	Air Force Test Structure #2
AF-3	Air Force Test Structure #3
AGTS-1	Above Ground Test Site #1
Alt. SHIST	Alternate Seismic Hardrock In Site Test

ANFO	ammonium nitrate-fuel oil
ATX-25R-M	A type of high explosive
BLEST	Blast Loading Explosives Simulation Technique
BLU	bomb live unit
C-4	Composition 4
COIL	chemical oxygen iodine laser
CTS-1	Counter-terrorism Structure #1
DET	Dilute Explosive Tile
DETASHEET	Explosive sheet made of PETN (a type of explosive)
DMMP	dimethyl methyl phosphate
DTA	Detonation Test Area
GBU	guided bomb unit
HE	high explosive
HEST	High Explosive Simulation Technique
HMX	cyclotetramethylenetetranitramine
IREMITE	emulsion explosives
ITB	Intermediate Testbed
JATO	Jet Assisted Take-Off
JDAMS	Joint Direct Attack Munitions
kg	kilogram
lbs	pound
LTB	Large Testbed
LTS-1	Large Test Structure #1
LTS-2	Large Test Structure #2
MBRS	Mobile Ballistic Research System
MeS	methyl salicylate
MK	bombs
MTD-3	Missile Technology Demonstration 3
MTTV	Maneuvering Tactical Target Vehicle
PTB	Pheonomenology Test Bed
PHETS	Permanent High Explosive Test Site
QM-100R	emulsion explosives
QM-100RA	emulsion explosives
SHIST	Seismic Hardrock In Situ Test Site
STORM	Missile & Associated Program
TEP	triethyl phosphate
TNT	trinitrotoluene

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APPENDIX B.

Proposed Chem/Bio Simulants, High Explosive, and Other Test Material

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Table 1. List of Proposed Chem/Bio Simulants, High Explosives, and Other Test Materials

Test Material	Mode of Employment	Expected Quantities Per Test	By-products (if any)*	Used in Previous Tests	Test Material Type
Chemical Simulants:					
Triethyl Phosphite (TEPI)	In tanks or drums	4000 gal	Toxic fumes of carbon monoxide, carbon dioxide, phosphorus oxides	None at WSMR	Chemical simulant
Triethyl Phosphate (TEP; TEPO)	In tanks or drums	4000 gal	Toxic fumes of carbon dioxide, carbon monoxide, phosphorus oxides when burned	DIPOLE TIGER 1, 2 DIPOLE JEWEL 4, 5 DIVIDE INVADER proposed	Nerve Agent precursor/simulant
Dimethyl Methylphosphonate (DMMP)	In tanks and drums	4000 gal	Toxic fumes of carbon monoxide, carbon dioxide, phosphorus oxides and/or phosphine	DIVINE INVADER proposed	Nerve Agent Precursor/simulant
Methyl Salicylate (MeS)	In tanks and drums	4000 gal	Toxic fumes under fire conditions: carbon monoxide, carbon dioxide	DIVINE INVADER proposed	Blister Agent Precursor/simulant
Thiodiglycol (TDG)	In tanks and drums	4000 gal	Toxic fumes of carbon monoxide, carbon dioxide, sulfur oxides, and hydrogen sulfide gas	DIVINE INVADER proposed	Blister Agent Precursor/simulant
Dowanol DPM Glycol Ether (DPM; DPGME)	In drums and tanks	4000 gal	Carbon dioxide, carbon monoxide, unidentified organic compounds	None at WSMR	G-Agent simulant
Biological Simulants					
Bacillus Thuringiensis (BT)	In bags, in canisters, or in water-filled drums	200 lb	NA	DIPOLE ORBIT 1, 2, 4, 5 (100 lb on previous WSMR tests)	Anthrax simulant
Bacillus Subtilis Variety Niger (Bacillus Globigii) (BG)	In bags, in canisters, or in water-filled drums	200 lb	NA	DIPOLE ORBIT 1, 3 DIPOLE EAST 159	Anthrax simulant
MS2 Bacteriophage	In bags, in canisters, or in water-filled drums	150 lb	NA	None at WSMR	Non-enveloped virus simulant
Noninfectious (killed) Influenza A Virus	In bags, in canisters, or in water-filled drums	150 lb	NA	None at WSMR	Enveloped virus simulant
Clostridium sporogenes	In bags, in canisters, or in water-filled drums	150 lb	NA	None at WSMR	Biological simulant
Lactic Dehydrogenase (LDH)	In bags, in	200 lb	Carbon dioxide, carbon monoxide	None at WSMR	Toxin simulant

Test Material	Mode of Employment	Expected Quantities Per Test	By-products (if any)*	Used in Previous Tests	Test Material Type
	canisters, or in water-filled drums				
Ovalbumin	In bags, in canisters, or in water-filled drums	200 lb	Carbon dioxide, carbon monoxide	None at WSMR	Toxin simulant
Tracers and Taggants					
Sulfur Hexafluoride	In bladders	250 lb	Sulfur oxides, hydrogen fluorides	DIPOLE ORBIT 1, 2, 3, 4, 5, 6 DIPOLE TIGER 1, 2	Plume tracer
Carbon Tetrafluoride	In bladders	150 lb	Carbon monoxide, carbon dioxide, hydrogen fluoride, thionyl fluorides	DIPOLE ORBIT 1, 2, 3, 4, 5, 6 DIPOLE TIGER 1, 2 DIPOLE JEWEL 1, 2, 4, 5	Plume tracer
Forane 134A	In bladders	100 lb	Carbon dioxide, carbon monoxide, hydrogen fluoride, hydrogen chloride, chlorine	DIPOLE JEWEL 4, 5	Plume tracer
Indium Oxide	In dry or wet simulant	100 lb	Unknown	DIPOLE ORBIT 2, 3, 4, 5	Plume tracer
Dyprosium Oxide	In dry or wet simulant	100 lb	Carbon dioxide, carbon monoxide	DIPOLE ORBIT 2, 3, 4, 5	Plume tracer
Alumina	Mixed with BW simulant	600 lb	None	DIPOLE ORBIT 2, 4, 5	Plume taggant
BAS-Oil Red Dye	Mixed with CW simulant	20 gal	Fumes, smoke, carbon monoxide, sulfur oxides, aldehydes, other oxides	DIPOLE JEWEL 4, 5	Dye, plume taggant
Locate Blue Liquid Dye	Mixed with CW simulant	40 gal	Carbon monoxide, nitrous oxides, acetic acid	Something similar on DIPOLE JEWEL 1, 2	Dye, plume taggant
High Temperature Incendiaries:					
HTI-1	In bomb	1000 lb	Boron oxide, phosgene gas, phosphorus chloride	Something similar on DIPOLE IDLE 2	Incendiary
HTI-2	In bomb	2	Carbon dioxide, carbon monoxide	Something similar on DIPOLE IDLE 2	Incendiary
HTI Igniter	In bomb	2	Carbon dioxide, carbon monoxide		Incendiary igniter
Interferents:					
Burning wood (burning organics)	piled or stacked	100 lb	Carbon dioxide, carbon monoxide	DIVINE INVADER proposed	Smoke interferent

Test Material	Mode of Employment	Expected Quantities Per Test	By-products (if any)*	Used in Previous Tests	Test Material Type
Burning plastic (burning organics)	piled or stacked	15 lb	Carbon dioxide, carbon monoxide, sulfur oxides, nitrogen oxides, unknown organic compounds	DIVINE INVADER proposed	Smoke interfent
Burning kerosene or diesel fuel (combustion products)	piled or stacked	100 gal	Carbon dioxide, carbon monoxide, sulfur oxides, unknown organic compounds	DIVINE INVADER proposed	Smoke interferent
Bleach	piled or stacked	55 gal	Carbon dioxide, carbon monoxide, chlorine gas, chlorine oxides	DIVINE INVADER proposed	Decontaminant interferent
Burning butyl rubber (burning organics)	piled or stacked	4 large tires	Carbon dioxide, carbon monoxide, unknown organic compounds	DIVINE INVADER proposed	Smoke interferent
High Explosives:					
Ammonium nitrate-fuel oil (ANFO)	In container placed on ground, suspended above ground, or in test structure	100 lb, 1000 lb, 2500 lb, 20 tons, 1 KT, 8 KT	Carbon dioxide, carbon monoxide, nitric oxide, ammonia, nitrogen dioxide, nitrous oxide, hydrogen cyanide, methane	DICE THROW, MILL RACE, Pre-DIRECT COURSE, DIRECT COURSE, MINI SCALE I-II, MINOR SCALE, MISTY PICTURE, MISERS GOLD, DISTANT IMAGE MINOR UNCLE, DIPOLE MIGHT 9, 15, 22, 30	Explosive mixture
Composition 4 (C-4) (91% RDX, 9% plasticiser)	In container placed in the open or in test structure, or suspended above ground	2 tons	Carbon dioxide, carbon monoxide, ethane, methane, propane, methanol, hydrogen cyanide, ammonia, formaldehyde	DIPOLE CHAIN 2.-3, 5-7, DIPOLE FAÇADE 2, DIPOLE DATE 1-8, DIPOLE EAST 9-12, 15-16 DIVINE BUFFALO 1-2, 4, 5-9, 19; DIPOLE FAÇADE 4, DIPOLE MIGHT 21, 23; DIVINE GLADIATOR 1/1A, 2-5	Explosive mixture
Cyclotrimethylenetrinitramine (RDX)	In container placed in the open or in test structure, or suspended above ground	1 ton	Carbon dioxide, carbon monoxide, nitrogen oxides		Explosive
Cyclotetramethylenetetranitramine	In container placed	1 ton	Carbon dioxide, carbon monoxide, nitrogen	MINERAL FIND 1-3,	Explosive

Test Material	Mode of Employment	Expected Quantities Per Test	By-products (if any)*	Used in Previous Tests	Test Material Type
(HMX)	on ground or suspended above ground		oxides	HURRICANE LAMP 1-4	
Emulsion Explosives Iregel-82,Iremite-62, QM-100, QM-100R	In container placed on ground, suspended above ground, or air-delivered in bomb	23 tons	Carbon dioxide, carbon monoxide, sodium carbonate, crystalline silica, acetylene, ethylene, methane, methanol, ammonia, formaldehyde	DIPOLE LIGHT 12, DIVINE ALBATROSS 7 DIPOLE EAST 20-22, 51, 158C, MIDDLE KEY 4,	Explosive mixture
Nitromethane (NM)	In container placed on ground or suspended above ground	20 tons	Carbon dioxide, carbon monoxide, nitrogen oxides	MISTY PORT 3, MIDNIGHT HOUR 1-2, DISTANT MOUNTAIN 1-3, HUSKY JAGUAR 1-2, HURRICANE PEAK 1	Explosive
Pentaerythritol tetranitrate	In container placed in the open or in test structure, or suspended above ground	1000 lb	Carbon dioxide, carbon monoxide, nitrogen oxides		Explosive mixture
Pentolite	In container placed on ground or suspended above ground	1000 lb	Carbon dioxide, carbon monoxide, nitrogen oxide, formaldehyde, methanol, hydrogen cyanide, methane, ammonia, propane, ethane, solid carbon	MISTY PORT 1-2	Explosive mixture
Trinitrotoluene (TNT)	In container placed in open, in test structure, or suspended above ground	500 lb	Carbon dioxide, carbon monoxide, nitrogen oxides	DIPOLE CHAIN 4, DIPOLE FAÇADE 1, 3, 5-6, DIPOLE EAST 159,	Explosive
Tritonal	In container placed on ground or air-delivered in bombs	1000 lb	Carbon dioxide, carbon monoxide, aluminum oxide, solid carbon, ethane, ammonia, hydrogen cyanide, propane, acetylene, methane, methanol, ethylene	DIPOLE EAST 13-14, 24A-24B, DIPOLE ORBIT 1, DIPOLE EAST 158,	Explosive mixture
Other Test Materials					
Polymethyl Methacrylate (PMMA)	Mixed with CW simulants	2300 lb	Carbon dioxide, carbon monoxide, monomeric methylmethacrylate	Used at WSMR for BMD	Thickener
Polystyrene-Butylmethacrylate	Mixed with CW	2300 lb	Carbon dioxide, carbon monoxide		Thickener

Test Material	Mode of Employment	Expected Quantities Per Test	By-products (if any)*	Used in Previous Tests	Test Material Type
(PSBA)	simulants				
Kaolin	In canisters	600 lb	Carbon dioxide, carbon monoxide		Thickener
Tergitol 15-S-9 Nonionic	Mixed with BW simulant	20 lb	Toxic fumes of carbon monoxide, carbon dioxide	DIPOLE EAST 169	Anticonglomerate
Phenol	Mixed with BW simulant	22 lb	Toxic fumes of carbon monoxide, carbon dioxide	DIPOLE EAST 169	Preservative
Magnesium chloride	25% solution applied at rate of 2.34 L/m^2	100,000 lb, 200,000 lb, or 250,000 lb	Magnesium oxychloride, hydrochloric acid vapor, chlorine gas	DICE THROW, MILL RACE, DIRECT COURSE, MINI SCALE I-II, MINOR SCALE, MISTY PICTURE, MISERS GOLD, DISTANT IMAGE MINOE UNCLE,	Dust suppressant

* Information from Material Safety Data Sheet

Table 2. Environmental Characteristics of Proposed Chem/Bio Simulants, High Explosives, and Other Test Materials

Test Material	Evaporation Rate/ Solubility in Water	Soil Adsorption Tendency	Expected tendency for leaching	Degradation Rates	Animal Toxicity: Lethal Concentration (LC_{50}) /Lethal Dose (LD_{50})	Carcinogenicity/ Human Toxicity
Chemical Simulants:						
[1]Triethyl Phosphite (TEPI)	NK / Insoluble	NK	Low	NK Hydrolysis: slow	Inhalation (mg/m^3): Mouse = 6203 for 6 hours Rat = 11063 for 6 hours Oral (mg/kg): Mouse = 3720 Rat = 1840 Skin (mg/kg): Rabbit = 2800	NK / eye skin, respiratory, and gastrointestinal irritant
[1]Triethyl Phosphate (TEP; TEPO)	Slow / Soluble	Low	High	In soil: slow; Biodegrad.: slow Photodegrad.: fast	Oral (mg/kg): Mouse = 1500 Rat = 1600 Inhalation (ppm): Rat – 28,000 Other toxicity: Fish-LC50 >100 mg/L	NK / Possible reproductive effects, cholinesterase inhibitor
[1]Dimethyl Methylphosphonate (DMMP)	Slow / Soluble	Low	High	In soil: moderate; Biodegrad.: NK Photodegrad.: NK Hydrolysis: slow	Oral (mg/kg): Mouse > 6810 Rat = 8210 Chicken = 3998	Possible carcinogen / Eye, skin, and respiratory irritant
[1]Methyl Salicylate (MeS)	Slow / Moderately soluble	Low	Moderate	In soil: moderate to fast; Biodegrad.: NK Photodegrad.: fast Hydrolysis: fast	Oral (mg/kg): Mouse = 1110 Rat = 887 Rabbit = 1300	NK / Eye, skin, and respiratory irritant
[1]Thiodiglycol (TDG) (thiodiglycolic acid) [1]Thiodiglycol (TDG) continued: (thiodiglycolic acid)	Very slow / Soluble	Low	High	Biodegrad.: none to moderate, depending on soil type. Photdegrad: none Hydrolysis: very slow	Oral (mg/kg): Rat = 6610 Guinea pig = 3960	NK / NK
[1]Dowanol DPM Glycol Ether (DPM; DPGME)	Slow / Soluble	Low	High	In soil: moderate; Biodegrad.: moderate; Photodegrad.: fast	Oral (mg/kg): Rat = 535 Skin (mg/kg): Rabbit = 950	NK / Slight eye irritant

Test Material	Evaporation Rate/ Solubility in Water	Soil Adsorption Tendency	Expected tendency for leaching	Degradation Rates	Animal Toxicity: Lethal Concentration (LC_{50}) /Lethal Dose (LD_{50})	Carcinogenicity/ Human Toxicity
					Other toxicity: Fish LC_{50} >150 mg/L	
Biological Simulants:						
[2,3]Bacillus thuringiensis (Bt) Variety kurstaki	Not Applicable/ Not soluble	Not Applicable	Not Applicable	In soil: moderate to fast Biodegrad.: NA Photodegrad.: fast	Inhalation (mg^3): Rat = 2,000-20,000 Oral (mg/kg): Rat = 500-5000 Skin (mg/kg): Rat = 2000-20,000 Other toxicity: Fish LC_{50} > 400 mg/L Insect death = 28mg/m^2	NK / Eye and skin irritant
[2,3]Bacillus Subtilis Variety Niger (Bg) (Bacillus globigii)	Not Applicable / Not soluble	Not Applicable	Not Applicable	In soil: slow	Other Toxicity: Fish LC_{50} > 400mg/L, 96 hr.	NK / Eye, skin, and respiratory irritant
[1]MS2 Bacteriophage	Not Applicable / Not Applicable	Not Applicable	Not Applicable	Not Applicable	Does not cause disease in animals	Does not cause disease in humans
[4]Noninfectious (killed) Influenza A Virus	Not Applicable / Not Applicable	Not Applicable	Not Applicable	Not Applicable	Does not cause disease in animals	Does not cause disease in humans
[1]Clostridium sporogenes	Not Applicable / Not Applicable	Not Applicable	Not Applicable	Not Applicable	Does not cause disease in animals	Does not cause disease in humans
[1]Lactic Dehydrogenase (LDH)	NK/NK `	NK	NK	NK	Not hazardous to animals	Not a carcinogen / Not hazardous to humans
[1]Ovalbumin	NK / Soluble	NK	NK	NK	Oral (mg/kg): Rat = 101,000	Not a carcinogen / Eye, skin, and respiratory irritant
Tracers and Taggants:						
[1]Sulfur Hexafluoride	NK / Slightly soluble	Not Applicable	Low	Atmosphere: very slow	Intravenous (mg/kg): Rat = 5790	Not a carcinogen / Could displace oxygen and cause suffocation
[1]Carbon Tetrafluoride	NK / Slightly soluble	NK	Low	Atmosphere: very slow	Inhalation (ppm): Rat = 895,000 for 15 minutes	NK / Skin irritant; could cause nausea, vomiting, disorientation, suffocation

Test Material	Evaporation Rate/ Solubility in Water	Soil Adsorption Tendency	Expected tendency for leaching	Degradation Rates	Animal Toxicity: Lethal Concentration (LC_{50}) /Lethal Dose (LD_{50})	Carcinogenicity/ Human Toxicity
[1]Forane 134A	NK / Slightly soluble	NK	Low	NK	Inhalation (ppm): Rat > 500,000 for 4 hours	NK / Slight eye and skin irritant; inhalation may cause dizziness, drowsiness, rapid heartbeat, suffocation
[1]Indium Oxide	NK / Insoluble	NK	Low	NK	Toxic to animals by ingestion	Not a carcinogen / Eye, skin, mucous membrane, and respiratory irritant
[1]Dyprosium Oxide	Slow / Insoluble	NK	Low	NK	Oral (mg/kg): Rat > 500	NK / May cause eye, skin, respiratory, and digestive tract irritation
[1]Alumina	NK / Insoluble	NK	Low	Not Applicable	NK	Not a carcinogen / minor eye, skin, and respiratory irritant
High Explosives:						
[1]Ammonium nitrate-fuel oil (ANFO)	Ammoniun nitrate evap moderate / low solubility Fuel oil evap low/highly soluble	Ammonium nitrate adsorption low Fuel oil adsorption high	Ammonium nitrate leaching high Fuel oil leaching moderate	Ammonium nitrate and fuel oil combined : Biodegrad: moderate Photodegrad: low In soil: moderate	Oral (mg/kg): Rat=3732	NK/ Eye, skin, and respiratory irritant
[1]Composition 4 (C-4) (RDX 91% & Plasticiser 9%)	Does not evap/Slightly soluble	Low	High	Biodegrad: low Photodegrad: moderate	Not Applicable	Not Applicable
[1,5,6] Cyclotrimethylenetrinitramine (RDX)	Does not evap/Slightly soluble	Low	High	Biodegrad: low Photodegrad: moderate	Oral (mg/kg): Rat <300	Not listed / Eye, skin, and respiratory irritant
[1&5]Cyclotetramethylenetetranitramine (HMX)	Not Applicable / Low solubility	Moderate	Moderate	Biodegrad: low Photodegrad: low	Oral (mg/kg): Mouse = 1500	Not listed / Eye, skin, and respiratory irritant
[1]Emulsion Explosives Iregel-82,Iremite-62, QM-100, QM-100R	Not Applicable / Not soluble	Not Applicable	Low	Not Applicable	Oral (mg/kg): Rat=3732 (if ammonium nitrate is an ingredient) Rat=3000 (if sodium nitrate is an ingredient)	Not listed / Eye, skin, and respiratory irritant; may cause serious pulmonary symptoms.
[1]Nitromethane	Fast / Slightly	Low	Low	Soil: Fast	Oral (mg/kg):	Not listed / Eye, skin, and

Test Material	Evaporation Rate/ Solubility in Water	Soil Adsorption Tendency	Expected tendency for leaching	Degradation Rates	Animal Toxicity: Lethal Concentration (LC_{50}) /Lethal Dose (LD_{50})	Carcinogenicity/ Human Toxicity
(NM)	soluble			Biodegrad.: Fast Photodegrad.: Fast	Rat=940	respiratory irritant; may cause nausea, headaches
[1]Pentaerythritol tetranitrate	Not Applicable / Not soluble	Mod-High	Moderate	Biodegrad Moderate	Not Applicable	Carcinogen / Eye, skin, and respiratory irritant; may cause nausea, headaches, dizziness, weakness
Pentolite (Pentaerythritol tetranitrate & TNT 50/50)	Not Applicable / Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable / Not Applicable
[1,5,6]Trinitrotoluene (TNT)	Not Applicable / Not soluble	Low	Not Applicable	Biodegrad Moderate Photodegrad Slow (in water)	Oral (mg/kg): Rat=795	Not listed / Eye, skin, respiratory irritant; may cause nausea, dizziness, weakness, confusion
Tritonal TNT & aluminum 80/20	Not Applicable / Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable / Not Applicable
Other Test Materials:						
[1]Polymethyl Methacrylate (PMMA)	Not Applicable / Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Carcinogen / Eye, skin, and respiratory irritant
[1]Polystyrene-Butylmethacrylate (PSBA)	Not Applicable / Insoluble	Not Applicable	Not Applicable	Not Applicable	Inhalation (ppm): Rat = 4910 for 4 hours Oral (mg/kg): Mouse = 12900 Rat = 1800 Rabbit = 2500 Skin (mg/kg): Rabbit = 11300	NK / Eye, skin, and respiratory irritant
[1]Kaolin	Not Applicable / Insoluble	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Carcinogen / Eye, skin, and respiratory irritant
[1]Tergitol 15-S-9 Nonionic	Slow / Moderately soluble	Not Applicable	Not Applicable	In soil: NA Biodegrad.: yes Photodegrad.: NA	Other toxicity (mg/L): Fish toxicity = 1-10	Not a known carcinogen / Eye, skin, and respiratory irritant
[1]Phenol	Slow / Soluble	Not Applicable	Not Applicable	In soil: NA	Inhalation (mg/m^3):	Not a carcinogen / Skin and

Test Material	Evaporation Rate/ Solubility in Water	Soil Adsorption Tendency	Expected tendency for leaching	Degradation Rates	Animal Toxicity: Lethal Concentration (LC_{50}) /Lethal Dose (LD_{50})	Carcinogenicity/ Human Toxicity
				Biodegrad.: NA Photodegrad.: yes	Mouse = 177 Rat = 316 Oral (mg/kg): Mouse = 270 Rat = 317 Skin (mg/kg): Rat = 669 Rabbit = 850 Other toxicity: Plant toxicity = 1 mg/L	respiratory irritant, may cause severe eye damage
[1]Magnesium chloride	Not Applicable / Soluble	Not Applicable	Not Applicable	NA	Oral (mg/kg): Rat = 8100	Not a known carcinogen / Eye, skin, respiratory, and gastrointestinal irritant
[1]Bleach	Not Applicable / Soluble	Not Applicable	Not Applicable	In soil: Not Applicable Biodegrad.: Not Applicable Photodegrad: Yes	Not Applicable	Carcinogen / Moderate to severe eye, skin, and respiratory irritant

[1] Information from Material Safety Data Sheet
[2] Information from The Pesticide Manual, 1994.
[3] Information from Crop Protection Reference, 1995.
[4] Personal communication, Kevin Oshima
[5] www.wes.army.mil.
[6] www.epppublications.com/Zakik.pdf
[7] www.epa.gov/safewater/dwh/t-ioc/nitrates.html
[8] See references in Appendix C

Table 3. Hazard Ratings of Proposed Chem/Bio Simulants, High Explosives, and Other Test Materials

Test Material	NFPA Rating			Listed as Hazardous by:			
	Health	Flammability	Reactivity	Manufacturer	DOT	EPA	Other
Chemical Simulants:							
Triethyl Phosphite (TEPI)	3	2	2	Yes	Class 3	Not listed	No
Triethyl Phosphate (TEP; TEPO)	3	1	1	Yes	Class 8	Yes	Yes (OSHA)
Dimethyl Methylphosphonate (DMMP)	3	2	1	Yes	Not regulated	Yes	No
Methyl Salicylate (MeS)	1	1	0	Yes	Not regulated	Not listed	No
Thiodiglycol (TDG) (thiodiglycolic acid)	2	1	0	Unknown	Not regulated	Not listed	No
Dowanol DPM Glycol Ether (DPM; DPGME)	1	2	0	Yes	Not regulated	Yes	Yes (OSHA)
Biological Simulants:							
Bacillus thuringiensis (Bt) Variety kurstaki	0	0	0	Not hazardous	Not regulated	Not listed	Biohazard 1 (CDC)
Bacillus Subtilis Variety Niger (Bg) (Bacillus globigii)	0	0	0	Not hazardous	Not regulated	Not listed	Biohazard 1 (CDC)
MS2 Bacteriophage	0	0	0	Not hazardous	Not regulated	Not listed	Biohazard 1 (CDC)
Noninfectious	0	0	0	Not hazardous	Not regulated	Not listed	Biohazard 1

Test Material	NFPA Rating			Listed as Hazardous by:			
	Health	Flammability	Reactivity	Manufacturer	DOT	EPA	Other
(killed) Influenza A Virus							(CDC)
Clostridium sporogenes,	0	0	0	Not hazardous	Not regulated	Not listed	Biohazard 1 (CDC)
Lactic Dehydrogenase (LDH)	0	0	0	Not hazardous	Not regulated	Not listed	No
Ovalbumin	0	0	0	Not hazardous	Not regulated	Not listed	No
Tracers and Taggants:							
Sulfur Hexafluoride	2	0	0	Yes	Class 2 Division 2	Yes	Yes (OSHA)
Carbon Tetrafluoride	1	0	0	Yes	Class 6 Division 1	Yes	No
Forane 134A	1	0	0	Yes	Class 2 Division 2	Yes	Yes (OSHA)
Indium Oxide	2	1	0	Yes	Not regulated	Not listed	No
Dyprosium Oxide	0	0	0	Not hazardous	Not regulated	Not listed	Yes (OSHA)
Alumina	1	1	1	Yes	Not regulated	Yes	Yes (OSHA)
High Explosives:							
Ammonium nitrate-fuel oil (ANFO)	1	2	4	Yes	Class 1 Division 5	Yes	No
Composition 4 (C-4)	NK	NK	4	NK	Class 1	Yes	No
Cyclotrimethylenet rinitramine (RDX)	1	3	4	Yes	Class 1 Division 1	Yes	Yes (OSHA)
Cyclotetramethylen etetranitramine	1	4	4	Yes	Class 1 Division 1	Yes	No

Test Material	NFPA Rating			Listed as Hazardous by:			
	Health	Flammability	Reactivity	Manufacturer	DOT	EPA	Other
(HMX)							
Emulsion Explosives Iregel-82,Iremite-62, QM-100, QM-100R	1	3	4	Yes	Class 1	Yes	Yes (OSHA)
Nitromethane (NM)	1	3	4	Yes	Class 3	Yes	Yes (OSHA)
Pentaerythritol tetranitrate	1	4	4	Yes	Class 1 Division 1	Yes	Yes (OSHA)
Pentolite	NK	NK	4	NK	Class 1 Division 1	Yes	No
Trinitrotoluene (TNT)	2	4	4	Yes	Class 1 Division 1	Yes	Yes (OSHA)
Tritonal	NK	NK	4	NK	Class 1 Division 1	Yes	No
Other Test Materials:							
Polymethyl Methacrylate (PMMA)	1	1	0	Yes	Not regulated	Not listed	Yes (OSHA)
Polystyrene-Butylmethacrylate (PSBA)	2	2	1	Yes	Not regulated	Yes	No
Kaolin	1	0	0	Yes	Not regulated	Not listed	Yes (OSHA)
Tergitol 15-S-9 Nonionic	2	1	1	Yes	Not regulated	Yes	Yes (OSHA)
Phenol	4	2	2	Yes	Class 6 Division 1	Yes	Yes (OSHA)
Magnesium chloride	2	0	0	Yes	Not regulated	Not listed	No
Bleach	3	0	1	Yes	Class 8	Yes	Yes

Test Material	NFPA Rating			Listed as Hazardous by:			
	Health	Flammability	Reactivity	Manufacturer	DOT	EPA	Other
							(OSHA)

ABBREVIATIONS and ACRONYMS

CDC	Center for Disease Control
DOT	Department of Transportation
EPA	Environmental Protection Agency
gal	gallons
hr	hours
KT	kilotons
lb.	pounds
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mg/m^3	milligrams per cubic meter
mg/m^2	milligrams per square meter
NA	not available
NFPA	National Fire Protection Association
NK	not known
OSHA	Occupational Safety and Health Administration
ppm	parts per million
psi	pounds per square inch
WSMR	White Sands Missile Range

DEFINITIONS

NFPA Ratings

Health

0 – Not a health hazard
1 – Irritation if touched or breathed but no destruction of tissue; minor injury if no medical treatment
2 – High irritation if touched or breathed ; temporary incapacitation or residual injury if no medical treatment
3 – Corrosive or toxic if touched or breathed; serious injury if no medical treatment
4 – Extreme hazard if touched or breathed, and can penetrate protective clothing; death if no medical treatment

Flammability
`

0 – Not a fire hazard
1 – Liquids, solids, and semisolids with flash point above 200°F
2 – Liquids with flash point between 100 °F and 200°F; solids and semisolids which give off flammable vapors
3 – Liquids with flash point between 73 °F and 100°F; materials which burn rapidly or ignite spontaneously with air
4 – Liquids with flash point below 73 °F; materials which form explosive mixtures with air; cryogenic materials

Reactivity

0 – Stable even under fire conditions; does not react with water
1 – Unstable at high temperatures and pressures; non-violent reaction with water
2 – Unstable at normal temperatures and pressures, but does not detonate; violent reaction with water
3 – Detonation possible at normal temperatures and pressures if strong thermal or mechanical shock; explosive reaction with water
4 – Detonation possible at normal temperatures and pressures if localized mechanical or thermal shock

Department of Transportation

Class 1 EXPLOSIVES

Division 1 **Mass explosion hazard**, where a mass explosion is an explosion which affects entire load instantaneously

Division 5 **Insensitive mass explosion hazard**, where mass explosion could occur but is highly unlikely to occur under normal transport conditions

Class 2 GASES

Division 2 **Flammable gas hazard**, where a flammable gas is defined as any material which is a gas at 68°F or less and 14.7 psi of pressure, and is ignitable at 14.7 psi when in a mixture of 13% or less with air.

Class 3 FLAMMABLE LIQUID HAZARD

A flammable liquid is defined as any liquid with a flash point of 141°F or less.

Class 6 POISONOUS MATERIALS

Division 1 **Human irritation or toxicity hazard**, where irritating material is defined as any material which causes symptoms similar to tear gas; and toxic material is defined as any material with a 50% lethal oral dose of at most 500 mg/kg (liquid) or 200 mg/kg (solid), a 50% lethal topical dose of at most 1000 mg/kg, or a 50% lethal inhalation concentration of at most 10 mg/L.

Class 8 CORROSIVE MATERIAL HAZARD

A corrosive material is defined as any material which causes destruction of human skin upon contact for a specified period of time.

Other Definitions

CDC

Biohazard 1 is defined as any biological agent that is not known to cause disease in healthy human adults and poses minimal potential hazard to the environment

EPA

Chemical substances listed as hazardous under EPA are monitored by at least one of the following EPA programs: Aerometric Information Retrieval System Facility Subsystem (AFS) for chemical releases into air; Permit Compliance System (PCS) for chemical releases into water; Toxic Release Inventory System (TRIS) for release of toxic substances into environment; and Resource Conservation and Recovery Information System (RCRIS) for hazardous waste.

OSHA

Chemical substances considered hazardous by OSHA are those substances which have an established Permissible Exposure Limit (PEL) as specified by OSHA, an established Threshold Limit Value (TLV) as specified by the American Conference of Governmental Industrial Hygienists (ACGIH), an established threshold limit as specified by the manufacturer, or are known to be a carcinogen as specified by the National Toxicology Program (NTP) or the International Agency for Research on Cancer (IARC).

APPENDIX C.

Summary of Potential Hazards of Simulants, Tracers and Taggants

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Summary of Potential Hazards of Simulants, Tracers and Taggants Proposed for Use at the Permanent High Explosive Test Site (PHETS), White Sands Missile Range, New Mexico

Introduction

Threat of weapons of mass destruction (WMD), such as pathogenic biological agents and highly toxic chemical agents, is cause for concern for the U.S. and its allies. As a result, the U.S. military conducts research on the human and environmental toxicity of these agents and methods of destruction of these agents. Because of the obvious hazards inherent in handling and releasing WMD, less pathogenic and less toxic agents are used in some tests as simulants of the actual agents.

Chemical and biological simulants have been used by the U.S. military for at least the last 57 years for testing and training. Research and development is conducted at the U.S. Army Soldier Biological Chemical Command (SBCCOM) at the Edgewood Arsenal of Aberdeen Proving Grounds, MD. For example, the Biological Integrated Detection System [BIDS] was developed at SBCCOM as a method of detecting biological warfare agents on the battlefield. Tests employing simulants have occurred at Dugway Proving Grounds, UT, White Sands Missile Range, NM, and the Nevada Test Site in order to test the sensitivity of equipment to detect WMD and model plume behavior. From plume data, predictions can be made about the movement of biological and chemical agents through the air after defeat of enemy production and storage facilities.

Simulants have also been used for training of troops at the U.S. Army Chemical School since 1990 (first located at Fort McClellan, AL and later moved to Fort Leonard Wood, MO) and Fort Polk, LA since 2000. At Fort Polk, troops are trained in the use of BIDS. At the U.S. Army Chemical School, troops are trained in the detection of WMD and decontamination techniques.

Continued testing employing simulants is proposed at White Sands Missile Range (WSMR) at the Permanent High Explosive Test Site (PHETS) in order to test the sensitivity of equipment to detect WMD and to model plume behavior under different scenarios. Simulants are chosen which mimic particular physical and/or chemical properties of the actual WMD agents. Biological simulants are bacteria and viruses that are closely related to biological warfare agents. Most of the chemical simulants are precursors (production intermediates) and/or degradation products of the actual chemical warfare agents. Although simulants are not nearly as injurious as actual WMD, some are considered hazardous under certain definitions (see Table 3 in Appendix B). The following sections contain a detailed literature review on the environmental fate and specific environmental and human hazards of each of the proposed simulants and related test materials.

Definitions of toxicity used in this document come from Munro et al. (1999). Toxicity may be acute (toxic after one-time exposure) or chronic (toxic after multiple or long-term exposures). The three routes of animal exposure to simulants are oral, inhalation, and dermal. Oral and dermal toxicities are determined by 50% lethal dose (LD_{50}), the dose at which half of the test organisms died. Inhalation toxicity is determined by 50% lethal concentration (LC_{50}), the atmospheric concentration at which half the test organisms died. Compounds that are considered to be of low acute toxicity are those that have an LD_{50} or LC_{50} greater than 500 mg/kg of body weight for oral and dermal exposure, and greater than 500 mg/m^3 of atmosphere for inhalation exposure. Compounds that are of moderate acute toxicity are those that have an LD_{50} or LC_{50} between 50-500 mg/kg (oral), between 200-500 mg/kg (dermal), and between 50-500 mg/m^3 (inhalation). Compounds that are of high acute toxicity are those that have LD_{50} or LC_{50} less than 50 mg/kg (oral), less than 200 mg/kg (dermal) and less than 50 mg/m^3 (inhalation). High acute toxicity for aquatic organisms is LC_{50} less than 1 mg/L. Levels of chronic toxicity are an order of magnitude less than those established for acute toxicity. For perspective, the following are acute oral LD_{50} values in rats for compounds encountered by humans regularly, reported in mg/kg of body weight: sugar = 29,700, ethanol = 7000, table salt = 3000, nicotine = 60.

Generally, the biological and chemical simulants proposed for use at PHETS are not highly toxic. However, some simulant compounds have a long lifetime in the environment (also called “persistence”). Persistent compounds have the potential to build-up in the soil or ground water, and may bio-accumulate in plants and animals. This document uses definitions of environmental persistence as outlined by Munro et al. (1999): moderate persistence refers to compounds that are stable for weeks to months (half-life between 2 and 16 weeks) and high persistence refers to compounds that are stable for months to years (half-life greater than 16 weeks).

Hazards of Biological Simulants

<u>Bacillus subtilis var. niger (Bg)</u>.

General Information. Bg is an aerobic bacterium that commonly occurs in soils around the world. It is closely related to *Bacillus anthracis*, the biological warfare agent that causes the disease anthrax. Bg is generally not pathogenic to humans, plants or animals (ENRD, 2000; Sietske de Boer & Diderichsen, 1991; ATCC, 2000; U.S. EPA, 1997). Bg is used commercially for the production of enzymes, antibiotics, and specialty chemicals (U.S. EPA, 1997) and as an additive to crop soil (Tomlin, 1994). Bg is capable of colonizing plant roots and deters the growth of disease microorganisms which attack root systems (Tomlin, 1994).

Environmental Fate and Hazards. In rare cases, Bg has been associated with livestock abortion and crop disease. The LC_{50} for fish is greater than 400 mg/L for a 96 hour exposure, indicating low toxicity to fish. Guinea pigs exposed to greater than 6×10^6 spores (dermal) and greater than 2×10^6 spores (inhalation) showed no ill effect. Because Bg produces antifungal and antibacterial compounds, addition of Bg to the soil may affect local soil microbial communities (U.S. EPA, 1997). Bg often exists in the environment in the form of dormant spores. Spores may persist in soil for long periods of time until conditions are adequate for reproduction, usually after amendment with utilizable organic matter (ENRD, 2000; U.S. EPA, 1997).

Human Hazards. In rare cases, Bg has caused infection in humans, including food poisoning, endocarditis, blood infection, eye infection, and bone infection. Infections such as these have occurred in only a handful of cases, and usually the victim was in a weakened condition, such as drug users, cancer patients, and children (Sietske de Boer & Diderichsen, 1991). Bg produces the enzyme subtilisin, which can cause allergic reaction in some people, especially after repeated exposure (U.S. EPA, 1997). Release of spores into the air may cause minor skin, eye and respiratory irritation. Bg spores that have been gamma-irradiated are nonviable and have none of the human or environmental hazards listed above, except as a minor eye and respiratory irritant when handled or released into the air (ENRMD, 2000).

Discussion. Because of the wide usage of Bg in industry and agriculture, the U.S. Environmental Protection Agency (EPA) conducted a risk assessment of Bg, in which the EPA concluded that both environmental and human risks associated with Bg are small (U.S. EPA, 1997). During testing at WSMR, personnel handling Bg and tracking plumes containing Bg will be at almost no risk with the use of personal protection equipment.

Movement of the plume across the WSMR boundary is unlikely to affect civilian populations because the concentration of Bg in the plume is likely to be very low at this point. The nearest WSMR boundary to PHETS is approximately 16 km. A previous test using Bg at PHETS found between 10 and 1000 colony forming units (CFU) at single point distances of 27 km from impact (DIPOLE ORBIT 1). These tests used half as much Bg as is proposed for future tests. Assuming that dispersion behavior is not influenced by the initial concentration of Bg, it is estimated that concentrations of Bg at a distance of 27 km from impact would be between 20 and 2000 CFU for a single point measurement. Concentrations of Bg at the nearest WSMR boundary would be higher than this, as it is closer to the impact site.

Aerial agricultural application of biological agents is usually between 16 and 30 billion international units (IU) per acre, where an IU is the quantity of Bg required to produce insect death. Unfortunately, it is not possible to directly compare the one-dimensional point measurements taken at previous tests on WSMR to two-dimensional measurements of standard agricultural *Bacillus* application; it is also difficult to compare CFU to international units. However, a study that applied less than the recommended dosage of *Bacillus thuringiensis* aerially to a 30-hectare area observed an average surface deposition of 20.7-26.1 CFU/cm^2 (Rodenhouse and Holmes, 1992). This implies that concentration of Bg at the PHETS boundary will be comparable to the lowest commercially recommended dosages. This estimate for Bg is based on a single empirical study and the extrapolation to 200lb. Bg per test assumes that all climatic, microclimatic, and other factors are constant from test to test. In fact, concentrations of Bg in the plume are variable from test to test, so it is possible that concentrations exeeding 2000 CFU/cm^2 could cross the WSMR boundary.

Soil microbes have an important function in desert ecosystems as decomposers and nutrient cyclers. Some microbes facilitate the uptake of nutrients by plants. Other microbes provide natural erosion control in the form of cryptogamic crusts or other forms of soil binding (Schlesinger, 1991). Addition of Bg in large quantities over a period of time at PHETS may cause changes in the natural balance of soil biota, thereby affecting decomposition rates, nutrient cycling, uptake of nutrients by plants, and rates of erosion.

Bacillus thuringiensis var. karstaki (Bt).

General Information. Bt is an aerobic bacterium commonly occurring in soils worldwide. It is closely related to *Bacillus anthracis*, the biological warfare agent that causes the disease anthrax. Bt is generally not pathogenic to humans or other mammals (ATCC, 2000; Swadener, 1994; Tomlin, 1994). Bt spores are commercially produced as insecticides which target moth, butterfly and beetle larvae (Tomlin, 1994). After insect larvae ingest Bt spores, endotoxins are produced which upset the ion balance within the insect gut, causing the insect to stop feeding. The insect eventually dies from starvation or from body-wide infection (Tomlin, 1994; Swadener, 1994).

Environmental Fate and Hazards. Bt is toxic to the water gobie fish at concentrations greater than 400 mg/L (Tomlin, 1994). There is evidence that Bt is toxic to fathead minnows in lower concentrations than those commonly used for insecticide application, although the toxicity may have been caused by other ingredients contained in the Bt insecticide powder (Swadener, 1994). Bt is also toxic to ringneck pheasants (Swadener, 1994). The LD_{50} for rats is greater than 500 mg/kg (oral) and greater than 2000 mg/kg (dermal). The LC_{50} for rats is greater than 2000 mg/m^3. Bt is lethal to moth and beetle larvae at 28 mg/m^2 (Crop Protection Reference, 1995). Although no research has focused on Bt toxicity to the White Sands Pupfish (*Cyprinodon tularosa*), the fathead minnow is a reasonable equivalent. Therefore, the effects on the White Sands Pupfish will be similar to those observed with the fathead minnow.

Bt is photosensitive and therefore has a very short lifetime in the soil, generally less than seven days (Tomlin, 1994); although, there are reports of viable Bt spores persisting in soil for up to one year and on foliage for up to two years (Swadener, 1994). Bt spores may persist in water for up to 200 days and are resistant to water treatment processes (Swadener, 1994).

Human Hazards. In rare cases, Bt has caused human infection, including eye infection and allergic reaction. As with Bg, people in a weakened state are more susceptible to Bt infection (Swadener, 1994). Release of spores into the air may cause minor skin, eye and respiratory irritation. Bt spores that have been gamma-irradiated are nonviable and have none of the human or environmental hazards listed above, except as a minor irritant when handled or released into the air.

Discussion. Bt is generally not hazardous to humans. With proper protective equipment, PHETS test personnel exposed to Bt will be at no risk to allergic reaction or infection. As with Bg, the quantities in the plume at 27 km from impact are expected to be between 20-2000 CFU at a single point, and pose a minimal risk to civilian populations.

Unlike Bg, Bt is short-lived in soil, and therefore is not likely to affect the naturally occurring soil microbial community. However, Bt may affect insect populations near PHETS and have indirect effects on those animals that rely on insects for food. Although

Bt specifically targets moths, butterflies and beetles. Large scale aerial application of Bt has been shown to decrease population sizes of beneficial and benign insects for up to two years after use. In this same study, birds and rodents that feed on insects were observed to decrease in both body size and population size during the two year period (Swadener, 1994). In the Chihuahuan Desert ecosystem, pollinators of natural vegetation are often moths (e.g. the yucca moth is an obligate pollinator of yucca). Insectivorous birds and rodents are also common. The concentration of Bt used in agriculture application is comparable to expected Bt surface deposition out of the plume near PHETS (see discussion under Bg); repeated deposition of viable Bt over a period of time may reduce the number of moths and beetles in the PHETS area, thereby affecting reproductive rates for some plants and population sizes of insectivorous animals with confined feeding areas.

Clostridium sporogenes.

General Information. *Clostridium sporogenes* is widely distributed in nature and is common in the intestines of animals. It is closely related to *C. botulinum*, the bacterium which produces the toxin that causes botulism. *C. sporogenes* does not produce a toxin and is non-pathogenic, but its spores are as difficult to kill as *C. botulinum* spores. For these reasons, *C. sprorgenes* is used as a mimic of *C. botulinum* in food industry research (FSCN, 1997).

Environmental and Human Hazards. *C. sporogenes* is not pathogenic to humans or animals (J. Botsford, pers. comm., 2001; ATCC, 2000).

Discussion. *Clostridium sporogenes* is not a human or environmental hazard, nor is it expected to interact with other simulants, tracers, or taggants to form hazardous compounds.

MS2 bacteriophage.

General Information. MS2 bacteriophage are viruses that are obligate parasites for bacteria. MS2 is widespread in nature, being present in soil, human waste, and sewage (MEOC, 2001). It has been used in past military testing at Dugway Proving Grounds, UT.

Environmental and Human Hazards. MS2 bacteriophage is not pathogenic to humans or animals (ATCC, 2000).

Discussion. MS2 bacteriophage are common soil biotic constituents. They are short-lived when subjected to UV light in sunlight and are sensitive to desiccation. Their application to the soil surface for tests may locally reduce the number of certain host bacteria, but the overall affect to bacterial populations in the underlying soil would not be significant (Dr. William Lindemann, soil microbiologist, New Mexico State University, pers. comm., 2001 [paraphrased]).

Noninfectious influenza A.

General Information. Noninfectious influenza A is a virus that has been killed and cannot infect any organism.

Environmental and Human Hazards. There are no environmental or human hazards of killed influenza A virus (K. Oshima, pers. comm., 2001).

Hazards of Chemical Simulants

Dimethyl methylphosphonate (DMMP).

General Information. DMMP is a chemical warfare agent precursor and is regulated by the Chemical Weapons Convention. DMMP is used in industry primarily as a flame retardant and plasticizer, although there are other uses as well. DMMP is used as a sulfur mustard agent simulant in laboratory tests at Dugway Proving Grounds, UT (S. Klauser, pers. comm., 2001). Production of DMMP in the U.S. is between 0.2 and 2 million pounds per year; it is not known how much is released into the environment (NTP, 2001a). Environmental and human toxicity of DMMP is largely unknown (Fluka Chemical Corporation, 2001).

Environmental Fate and Hazards. DMMP causes low birth weight and retarded fetal physiological development in rodents. There is some evidence that DMMP causes kidney cancer in rats (NTP, 2001a). The acute oral LD_{50} for DMMP is greater than 6810 mg/kg for mice, 8210 mg/kg for rats, and 3998 mg/kg for chickens.

Abiotic degradation of DMMP occurs in both water and moist soils, where it hydrolyzes to the half ester and methanol. One estimate lists the hydrolysis half life for DMMP at 13.2 years. Other forms of DMMP degradation in the environment, such as biotic or photolytic, are unknown (Howard et al., 1986). A U.S. Army study reported that DMMP has a half-life of 60 days in the soil and a half-life of 210 days in water, suggesting that other non-hydrolysis modes of degradation are important (Howard et al., 1986). DMMP vapor has a half-life of 48 days in the atmosphere. DMMP is highly water soluble with a tendency to leach into ground water. The EPA lists it as a water pollutant, with maximum concentration in drinking water limited to 100μg/L (U.S. EPA, 2000).

Human Hazards. The U.S. Army Hygiene Agency has adopted a recommended exposure limit (REL) of 20.0 mg/m^3 (20.0 ppb) of DMMP, bearing in mind that this is the highest concentration recommended for continuous human exposure. A dispersal model for TEP (assumed to be essentially similar to DMMP and other chemical simulants) predicted a plume concentration of approximately 4.0 ppb after 1-1.5 hours some 20-25 km downwind (FCDSWA, 1998). Although high concentrations at the detonation site would be expected briefly after a test, levels would dissipate rapidly after the first day.

The lowest observed adverse effect level (LOAEL) for DMMP is reported at 179 mg/ kg body weight/day (Rowland et al., [no date], EPA report). A 70-kg human would have to ingest over 12,000 mg of DMMP before deleterious effects are noted. This potential exposure is not conceivable in any planned test scenarios at PHETS.

DMMP vapor or mist may cause eye, skin and respiratory irritation and is listed by OSHA as a possible human carcinogen (Fluka Chemical Corporation, 2001). Reported cargenogenic potential was based on studies with rats, but amounts administered were large and occurred over an extended time period (Rowland et al., [no date], EPA report). DMMP is not approved for use in open air studies at Dugway Proving Grounds, UT because of its potential carcinogenic properties (J. Martin & S. Klauser, pers. comm., 2001).

Discussion. Risk of exposure to DMMP by test personnel will be minimized with use of proper protective equipment. Based on previous tests employing TEP, concentration of DMMP in plume at the WSMR boundary is expected to be approximately 0.012 mg/m^3 (0.012 ppb), which is .06 percent of the continuous relative exposure limit. Since the tests are not continuous and the concentration at the boundary is so small, off-site human populations are not likely to be affected.

DMMP has apparent low acute toxicity in animals based on high LD_{50} values. DMMP is moderately to highly persistent in the environment. The potential for DMMP to bioaccumulate is not known, nor are the effects of DMMP on plants and soil microbes known; therefore, it is not possible to assess the chronic ecotoxicity at PHETS.

DMMP is highly water soluble and has the potential to leach into ground water; however, it is not expected that DMMP will reach ground water at PHETS. At PHETS, depth to ground water varies from approximately 20 to 80 meters, with a thick caliche layer above it. This makes it unlikely that DMMP and other water soluble chemical simulants will reach ground water. In addition, ground water at PHETS is mostly brackish (1,000-10,000 mg/L) and is non-potable.

Dowanol DPM glycol ether (DPM).

General Information. DPM is an organic solvent contained in household cleaners, paints, inks and dyes, hydraulic brake fluid, cosmetics and pesticides. Annual production of DPM in the U.S. is between one and ten million pounds. It is not known how much DPM is released into the environment. DPM is used by the U.S. military as a simulant of G-nerve agents (Howard et al., 1986).

Environmental Fate and Hazards. DPM is mildly acutely toxic to rats by inhalation, with 500 mg/m^3 for 7 hours causing slight central nervous system depression. DPM causes death to dogs at 0.5-0.6 mL/kg by intravenous exposure. DPM is moderately toxic to rabbits after chronic exposure to skin (65 doses over 90 days), with no death occurring for 3 mL/kg doses, some death at 5 mL/kg doses, and significant death at 10 mL/kg doses. Inhalation is mildly toxic in some animals after chronic exposure: 400 mg/m^3 over 7 days for monkeys, 800 mg/m^3 over 186 days for rabbits, and 1500 mg/m^3 over 184 days for rats and guinea pigs caused slight central nervous system depression, and slight liver, kidney, and lung damage. The acute oral LD_{50} for rats is 535 mg/kg and the acute dermal LD_{50} for rabbits is 950 mg/kg. The acute LC50 for the emerald shiner fish is greater than

150 mg/L (Dow Chemical Co., 1999).

Modes and products of DPM degradation in soil and water are unknown (Howard et al., 1986). DPM degrades in soil over a period of days or months. It is highly water soluble and is likely to leach into ground water (Dow Chemical Company, 1999). Photochemical degradation of DPM is rapid, and hence, it is very short-lived in the atmosphere (half-life of 3.4 hours). DPM is monitored by the EPA as an air pollutant (EPA website).

Human Hazards. Overall toxicity of DPM to humans is low. DMP is a minor eye and skin irritant and causes respiratory irritation if vapor concentrations greater than 300 mg/m^3 are inhaled. The PEL for DPM is 100 mg/m^3 for 8 hr. exposure with immediate danger to life at 600 mg/m^3 (Dow Chemical, 1999).

Discussion. Because acute and chronic human toxicity is very low for DPM, no impacts on test personnel or civilian populations are expected due to its use at PHETS. Use of proper protective equipment will minimize discomfort of personnel who handle or are otherwise exposed to DPM.

DPM is moderately persistent in the environment, so is not likely to build up to high concentrations in soil. DPM has low toxicity in animals, so is not expected to directly impact animal populations at PHETS. DPM is used in insecticide formulations, but information on its direct toxicity to insects could not be found. Effects of DPM on vegetation and soil microbes are not known, so it is not possible to assess effects of DPM on plants, soil microbial processes, or indirect effects on animal populations at PHETS.

Methyl salicylate (MeS).

General Information. MeS is an organic compound that is naturally produced by some plants as an herbivore defense (Howard et al., 1986; Seskar et al., 1998). MeS is also an insect pheromone (Andersson et al., 2000). MeS, known as Oil of Wintergreen, is closely related to salicylate, the pain reliever in aspirin. MeS is produced commercially as a pain reliever in topical ointments, a flavoring agent in foods and candies, a fragrance in perfumes, an ultraviolet absorber in sunscreens, and an insecticide (NTP, 2001b; Agelopoulos et al., 1999).

Environmental Fate and Hazards. MeS is mildly toxic to mice, rats, and rabbits, with an acute oral LD_{50} of 1110 mg/kg, 887 mg/kg, and 1300 mg/kg, respectively. MeS caused mild skin and eye irritation to rabbits after a 24-hour exposure to a 500 mg dose (Mallinkrodt, 2000). MeS is not likely to bioconcentrate in fish (Howard et al., 1986). MeS was found to be severely toxic to plants after aerosol deposition on foliar surfaces of 4 $\mu g/cm^2$, although plants recovered within two weeks (Cataldo et al., 1993).

MeS is relatively short-lived in the soil and water, where it biodegrades, evaporates, or hydrolizes (S. Klauser, pers. comm., 2001; Mallinkrodt, 2000; Howard et al., 1986). Hydrolysis half-life of MeS in water of pH 7.5 is 22 days; at pH greater than 7.5, the rate of hydrolysis increases. Hydrolysis rate in moist soil is the same as in water (Howard et al., 1986). Rates of biodegradation and evaporation were not reported. In the atmosphere, MeS is degraded by reaction with hydroxyl radicals. MeS is also removed from the atmosphere by wet deposition. Atmospheric half-life of MeS is between one and ten days (Mallinkrodt, 2000).

Human Hazards. MeS is moderately toxic to humans when ingested. Five milliliters of concentrated MeS is equivalent to almost 22 adult aspirin tablets (Botma et al, 2001). The lowest published lethal doses of MeS for humans range from 101 mg/kg to 1480 mg/kg (NTP, 2001b). MeS is a severe respiratory, skin, and eye irritant. According to the National Toxicology Program (NTP), MeS may cause birth defects (NTP, 2001b; Mallinkrodt, 2000). Severe interaction between the drug warfarin and low dose exposure to MeS has been reported. No PEL has been established for MeS.

Discussion. Risk of exposure to MeS by test personnel will be minimized with use of proper protective equipment. Based on previous tests using TEP, concentration of MeS in the plume at the WSMR boundary is expected to be approximately 0.012 mg/m^3, so affect of MeS on off-site human populations is unlikely.

MeS is short-lived in the environment, so build-up of MeS in soil and ground water at PHETS is not expected. MeS has a high octanol/water partition coefficient (K_{ow}) of 275.4, so it is likely to bioconcentrate in terrestrial plants and animals; this is not that surprising, considering that it naturally occurs in some plants and insects. MeS has varied effects on insects, predators of insects, and parasites of insects, either through direct toxicity or by pheromone-influenced behavior (Agelopoulos et al., 1999; Lindberg et al., 2000; Andersson et al., 2000; Drukker et al., 2000). Therefore, it is possible for MeS to impact insect populations at and near PHETS. Changes in insect populations caused by MeS could have indirect effects on those animals that rely on insects for sustenance, such as rodents, bats, and birds.

<u>Thiodiglycol (TDG).</u>

General Information. TDG is a hydrolysis product of the sulfur mustard chemical warfare agent, HD. It is produced commercially for use in inks and dyes, antifreeze solutions, and is used as a costabilizer in the production of polyvinylchloride (Munro et al., 1999). TDG is used by the U.S. military as a simulant of HD.

Environmental Fate and Hazards. Acute toxicity of TDG in rats and guinea pigs is low, with an oral LD_{50} of 6610 mg/kg and 3960 mg/kg, respectively. External exposure of 500 mg TDG to rabbits caused moderate eye irritation and mild skin irritation. Chronic toxicity in rats is also low, where 5000 mg of TDG/kg/day over 90 days resulted in mild body weight change and mild kidney damage. Small bluegill sunfish exposed to 1000 mg/L for 42 days showed no effects, suggesting that TDG is nontoxic to aquatic organisms. Likewise, TDG appears to be nontoxic to plants, as aerial application of 1 lb TDG/acre showed no effect on crop plants. TDG showed no toxic effects on soil microbes. The low K_{ow} values (<2) indicate low potential to partition to the lipid phase in organisms, which shows little potential for bioconcentration (Munro et al., 1999).

TDG is water soluble and has the potential to leach into ground water. TDG does not photolyze, and hydrolysis rates are extremely slow (Munro et al., 1999). TDG may biodegrade in soil where at least one of two strains of bacteria are present (*Alcaligenes xylosoxidans* and *Pseudomonas pickettii*). However, biodegradation rates are not fast, ranging from no biodegradation to $6.26x10^{-6}$ mol/L/hr., depending on soil type (Lee and Allen, 1998).

Human Hazards. There is little information on the human hazards of TDG. No PEL or TLV has been established for TDG, although it is classified as an occupational eye, skin and mucous membrane irritant. Based on human toxicity of similar compounds and toxicity of TDG in other mammals, the recommended RfD value for TDG is 500 μg/kg/day (Munro et al., 1999).

Discussion. Despite the small amount of human hazard information, it appears that human toxicity of TDG is low based on the high RfD. Use of proper protective equipment (safety glasses and adequate ventilation) will minimize exposure of test personnel to TDG. Based on previous tests employing TEP, concentration of TDG in the plume at the WSMR boundary is expected to be approximately 0.012 mg/m^3, so civilian human populations will be at little to no risk.

Given the high LD_{50} for TDG and evidence that it has no toxic effects on plants or soil biota, TDG is not expected to have an impact on vegetation, soil microbes, or animal populations at PHETS. However, TDG rates of degradation are slow to non-existent, so TDG is expected to persist in soil and has the potential to buildup in the environment at PHETS with repeated use. The liklelihood of TDG reaching groundwater is low because of the lack of frequent heavy rains and the depth to groundwater in the PHETS area.

<u>Triethyl phosphate (TEP).</u>

General Information. TEP is an impurity in, and degradation product of, the chemical nerve agent GA (Munro et al., 1999). TEP is produced commercially for use as an intermediate in pesticide production, a fire retardant, and as an ethylating agent in other production processes (Howard et al., 1986; Micromedex, 1997). In 1986, the U.S. produced nearly 2.3 kilotons of TEP; it is not known how much is released into the environment. TEP is used by the U.S. military as a simulant of G-agent chemical warfare (Howard et al., 1986).

Environmental Fate and Hazards. Acute toxicity of TEP in mice and rats is low, with acute oral LD_{50} of 1500 mg/kg and 1600 mg/kg, respectively and a lowest lethal acute inahaltion concentration of 28,000 ppm over six hours for rats (FCDSWA, 1998). The LC_{50} for flathead minnows is greater than 100 mg TEP/L over four days. A study of carp indicated that TEP will not bioconcentrate in aquatic organisms (Micromedex, 1997). TEP affects soil microbes depending on soil type at greater than 10 μg TEP/g soil. In Nickel-Tencee soil from WSMR, TEP did not affect soil microbial activity, but in Mimbres-Glendale and Yesum-Holloman soils from WSMR, soil microbial activity decreased (Giordano et al., 1992). TEP was shown to cause a decrease in plant growth at greater than 400 mg TEP/m^2 for tomatoes, sorghum-sudangrass, and glossy privet grown on WSMR Nickel-Tencee soil (Sikora et al., 1994).

TEP is water soluble and may leach into ground water, where degradation rates are slow. Hydrolysis and evaporation of TEP in water and soil are insignificant modes of degradation. Evaporation of TEP is essentially non-occurring, and TEP hydrolysis half-life is 114 years (Howard et al., 1986; Micromedex, 1997). Biodegradation of TEP may occur in soil, but rates are slow (Micromedex, 1997). TEP readily degrades in the atmosphere through reaction with hydroxyl radicals; the atmospheric half life of TEP is seven hours (Micromedex, 1997).

Human Hazards. No PEL or TLV has been established for TEP. The human oral lethal dose can range from 500 to 5000 mg TEP/kg of body weight. Exposure to high concentrations of TEP may cause mild cholinesterase inhibition, including an anaesthetic-like effect, muscle relaxation, and other symptoms associated with a depressed central nervous system (ECDIN, 1998).

Discussion. Toxicity of TEP in humans is low. Use of proper protective equipment will minimize exposure of test personnel to TEP. In previous tests employing 3217 and 3204 gallons of TEP at WSMR (DIPOLE JEWEL 4 & 5, respectively), the concentration of TEP in the plume was less than 0.002 mg/m^3 at a distance of 600 meters from explosion site (DIPOLE JEWEL 4), and at most 0.01 mg/m^3 at a distance of 717 meters from explosion site (DIPOLE JEWEL 5). Tests are proposed using 4000 gal. of TEP. Assuming that the initial amount of TEP does not affect dispersion behavior, it is estimated that surface deposition will be between 0.0024 and 0.012 mg/m^3 TEP at these distances. The nearest WSMR boundary to PHETS is 16 km away. The amount of TEP in the plume at this point will be less than that observed at 600 m and 717 m, an extremely low concentration. Therefore, it is not expected that tests using TEP will affect off-site populations. This estimate for TEP is based on two empirical studies and the extrapolation to 4000 gal. assumes that all climatic, microclimatic, and other factors are constant from test to test. In fact, concentrations of TEP in the plume are variable from test to test, so it is possible that concentrations exeeding 0.012 mg/m^3 of TEP and other chemical slimulants could cross the WSMR boundary.

Acute animal toxicity of TEP appears to be low, given high LD_{50} and LC_{50} values. Hence, no immediate direct effects on animal populations are expected at PHETS due to use of TEP. Soil microbial activity at PHETS may be affected in areas where Yesum-Holloman soil occurs. Nickel-Tencee soil, which showed no decrease in soil microbial activity after TEP application, also occurs at PHETS. In these areas, no effect on soil microbes are expected. The predominant soil type at PHETS is the Berino-Dona Ana association; it is not known how TEP affects soil microbes in this soil type. TEP is long-lived in the environment and has the potential to buildup in the soil to concentrations that may affect plant growth. In addition, chronic animal toxicity of TEP is not known, so impacts on plant and animal communities may occur with repeated use of TEP.

<u>Triethyl phosphite (TEPI).</u>

General Information. TEPI is a chemical warfare agent precursor and is regulated by the Chemical Weapons Convention. TEPI is listed as a high production volume (HPV) chemical by the EPA.

Environmental Fate and Hazards. Acute toxicity of TEPI in mice, rats, and rabbits is low, with oral LD_{50} of 3720 mg/kg for mice and 1840 mg/kg for rats. The dermal LD_{50} for rabbits is 2800 mg/kg. The inhalation LC_{50} for mice is 6203 mg/m^3 over six hours and for rats is 11,063 mg/m^3 over six hours (Acros Organics, 2000).

Little is known about the environmental fate of TEPI. It is insoluble in water, so is not likely to leach into ground water. Modes and rates of degradation are unknown, so it is not possible to determine the persistence of TEPI in the environment.

Human Hazards. There is limited information on the human hazards of TEPI. TEPI may cause eye, skin, gastrointestinal, and respiratory irritation (Acros Organics, 2000). Because TEPI is an organic phosphorus-containing compound, it may be an acetylcholinesterase inhibitor; exposure to TEPI may cause central nervous system depression.

Discussion. Based on high acute LD_{50} and LC_{50} values for rodents, it is likely that TEPI is of low acute toxicity to humans as well; although there are no PEL or TLV standards set for the chemical. Use of proper protective equipment will minimize exposure of test personnel to TEPI. Based on previous tests employing TEP, concentration of TEPI in the plume at the WSMR boundary is expected to be approximately 0.012 mg/m^3, so effects on civilian human populations are unlikely.

Environmental toxicity of TEPI has not been widely studied. Because TEPI is of low acute toxicity to rats, mice and rabbits, it is not expected that TEPI will impact mammal populations at PHETS. Effects of TEPI on birds, fish, insects, plants and soil microbes has not been researched, so it is difficultto assess this set of environmental effects..

Plume tracers and taggants

<u>Carbon tetrafluoride (CF_4).</u>

General Information. CF_4 is a perfluorocarbon gas (PFC) that is used in semi-conductor processing and aluminum production (Sematech, 1994; EIIP, 1999). It is also known as Halon 14, which is used as a fire suppressant, and Freon 14, which is used as a refrigerant (Lewis, 1992a). Approximately 27,000 metric tons of CF_4 are released annually into the atmosphere worldwide by the aluminum industry alone (EIIP, 1999; Sematech, 1994). PFCs, including CF_4, are greenhouse gases that trap infrared energy emitted from the earth (Sematech, 1994); atmospheric release of CF_4 is monitored by the EPA. CF_4 is used by the U.S. military as a tracer gas in plume modeling studies.

Environmental Fate and Hazards. CF_4 is essentially non-toxic, with an acute inhalation LC_{50} of 895,000 ppm for a 15 minute exposure to rats. CF_4 is inert, and generally poses no health or environmental risk, except as a global warming agent (EIIP, 1999). Atmospheric lifetime of CF_4 is greater than 50,000 years (Sematech, 1994).

Human Hazards. CF_4 in liquid form may cause frostbite to exposed tissue due to rapidly volatilizing liquid and vapor. Because CF_4 gas is heavier than air, it may displace oxygen in non-ventilated areas, causing headache, dizziness, anesthesia, drowsiness, and other symptoms of oxygen deficiency. No PEL or TLV has been established.

Discussion. Test personnel exposed to CF_4 will be at no risk if proper protective equipment is used. CF_4 is not expected to have any impact on off-WSMR human populations. CF_4 is not expected to have any impact on terrestrial or aquatic environments at and near PHETS. Proposed release of CF_4 at PHETS is 150 lb. per test. Even if CF_4 was used at maximum proposed quantities (assuming 8 pretests per year, for a total of 1200 lb. annually), this is five orders of magnitude less than annual releases of this gas by industry. Therefore, use of CF_4 at PHETS will not contribute significantly to atmospheric concentrations (0.002% of total annual global emissions).

<u>Forane 134a (HFC-134a).</u>

General Information. Forane 134a is a trade name for HFC-134a. HFC-134a is a hydrofluorocarbon gas used as an alternative for chlorofluorocarbons (CFC), which are ozone-depleting gases. HFC-134a does not deplete ozone. HFC-134a is used commercially as a refrigerant in automotive air conditioning, supermarket refrigerator cases, and household refrigerators. In addition, HFC-134a is used in polymer foam blowing and aerosol products (DuPont, 1997). In 1999, total global production of HFC-134a was 133,662 metric tons, with 71,800 metric tons released into the atmosphere. Since 1990, a total of 237.8 metric tons of HFC-134a has been released into the atmostphere worldwide (AFEAS, 2000). Because of its low toxicity, nonflammability, and its ozone depletion potential of zero, HFC-134a is used as a tracer gas for plume modeling studies conducted by the U.S. military.

Environmental Fate and Hazards. The acute inhalation LC_{50} for rats is greater than 500,000 ppm for a four hour exposure, suggesting that HFC-134a is practically nontoxic. Acute external exposure over a 24-hour period caused slight eye and skin irritation to rabbits. A chronic toxicity study of HFC-134a on guinea pigs showed no allergic reaction after repeated skin exposure and no effects on rats after repeated external and oral exposure over a six week period. Bioaccumulation of HFC-134a does not occur in rats (Elf Atochem, 1999).

HFC-134a is only slightly water soluble, so is not likely to leach into ground water. HCF-134a gas readily mixes with the atmosphere. In the atmosphere, HFC-134a gas degrades to trifluoroacetic acid through reaction with hydroxyl radicals (Peterson et al., 1999). When exposed to high temperatures, as from an explosion, HFC-134a degrades to hydrogen fluoride (DuPont, 1997).

Human Hazards. HFC-134a is practically nontoxic to humans, but in very high concentrations may cause eye and respiratory irritation. HFC-134a in liquid form may cause frostbite to exposed tissue due to rapidly volatilizing liquid and vapor. Because HFC-134a gas is heavier than air, it may displace oxygen in non-ventilated areas, causing headache, dizziness, anesthesia, drowsiness, and other symptoms of oxygen deficiency

(Elf Atochem, 1999). The TLV for HFC-134a is 1000 ppm (4240 mg/m^3).

Discussion. Test personnel exposed to HFC-134a will be at no risk if proper protective equipment is used. HFC-134a is not expected to have any impact on off-WSMR human populations. Given that HFC-134a is used in its gas form for testing, and readily reacts with the atmosphere, it is not expected to have any impact on terrestrial or aquatic environments at and near PHETS.

Sulfur hexafluoride (SF_6).

General Information. Sulfur hexafluoride is a perfluorocarbon (PFC) gas commonly used in industry by electric utility companies. Research-grade SF_6 is pure, but industrial-grade SF_6 contains toxic disulfur fluoride impurities (Lewis, 1992b). Global annual emissions of SF_6 are estimated at 2500-5000 metric tons (Sematech, 1994). Because SF_6 is heavier than air and easily detected, it is used as a tracer gas in atmospheric studies. SF_6 is considered a greenhouse gas and release of this gas is monitored by the EPA.

Environmental Fate and Hazards. The acute intravenous LD_{50} for rats is 5790 mg/kg. SF_6 is generally not toxic to animals and plants, except under fire conditions. At temperatures at or above 400^{o}C, SF_6 decomposes into toxic thionyl fluoride compounds (BOC gases, 1999). SF_6 has an atmospheric lifetime of 3200 years (Sematech, 1994).

Human Hazards. SF_6 is generally not toxic to humans; however, SF_6 in liquid form may cause frostbite to exposed tissue due to rapidly volatilizing liquid and vapor. Because SF_6 gas is heavier than air, it may displace oxygen in non-ventilated areas, causing headache, dizziness, anesthesia, drowsiness, and other symptoms of oxygen deficiency. No PEL or TLV for SF_6 has been established.

Discussion. Because SF_6 is generally nontoxic, it is not expected to affect off-site human populations or vegetation and animal communities at and near PHETS. Personnel handling SF_6 or tracking plumes containing SF_6 will be at no risk with the use of proper protective equipment, whether pure SF_6 is used or SF_6 containing toxic impurities. Release of SF_6 for plume tracking will contribute less than 0.04% to total global annual releases of this gas by industry and other users (proposed maximum annual release of 0.9 metric tons [2000 lb.] by testing, compared to 2500-5000 metric tons released annually worldwide).

Plume taggants.

General information. Most plume taggants at PHETS are exotic materials meant for one-time use only. They are released along with simulants and are used to visually track the plume. Rare earth oxides used as taggants are generally non-toxic and include alumina, dysprosium oxide, and indium oxide. Kaolin, a clay used in ceramics, is also used as a plume taggant and is non-toxic.

Environmental Fate, Hazards, and Human Hazards. None of the rare earth materials are hazardous to humans, plants, or animals and pose no risk to the environment (Molycorp, 1999). Because these taggants are powders, they may cause minor irritation to the eyes and respiratory tract when suspended in the air. The PEL for alumina is 5 mg/m^3; for dysprosium oxide is 3 mg/m^3; and for kaolin is 5 mg/m^3. There is no established PEL or TLV for indium oxide.

Discussion. With proper protective equipment, personnel involved in tests employing taggants are at no risk. Taggants are not expected to impact off-site human populations or the environment at and near PHETS.

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APPENDIX D.

Biological Report

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BIOLOGICAL REPORT
FLORAL AND FAUNA SURVEYS

CONDUCTED IN SUPPORT OF THE
PROGRAMMATIC ENVIRONMENTAL ASSESSMENT FOR THE
PERMANENT HIGH EXPLOSIVE TEST SITE AND BEDROCK
PENETRATION TEST SITES
WHITE SANDS MISSILE RANGE, NEW MEXICO

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INTRODUCTION

The Defense Threat Reduction Agency (DTRA) is a tenant organization that operates and manages several test sites on White Sands Missile Range (WSMR). A Programmatic Environmental Assessment (*PEA*) is in the process of being prepared which will address several different types of test activities at the Permanent High Explosive Test Site (PHETS). Proposed activities include static high explosive and warhead penetration testing, collateral damage assessment and counter-terrorism tests. Bedrock penetration and small static high explosive testing is also proposed for the Seismic Hardrock In Situ Test (SHIST) Site and the Alternate SHIST (Alt. SHIST) Site.

In support of the *PEA*, surveys were conducted by Newtec/Walcoff Technologies (WALCOFF) to describe the biological resources present at PHETS, SHIST, and Alt. SHIST sites. These surveys were done to determine presence/absence of species in order to develop a baseline inventory of flora and fauna, and to identify any threatened, endangered, or sensitive (TES) species and WSMR species of interest (SOIs) present at the three sites. Areas designated for construction or site expansion were specifically targeted for surveys. The remaining areas were selected based on vegetation type with emphasis on undisturbed areas. Areas heavily impacted by previous testing were not specifically surveyed as part of this effort. Previous surveys and existing vegetation data were also used to determine if any TES species or WSMR species of interest (SOIs) might be present at one or more of the three sites.

AREA DESCRIPTION

PHETS, SHIST, and Alt. SHIST are located in the northern portion of WSMR (Figure 1). PHETS, the largest of the three sites, is approximately 9068 ha (22,407 ac) with most activities taking place in three test beds totaling 2,123 ha (5,246 ac). Historically the Large Test Bed has been used for large scale static high explosive tests. It presently contains hardened structures and infrastructure for penetration testing and collateral damage assessments as well as a construction landfill and cable yard. The Intermediate and Phenomenology test beds are smaller relative to the Large Test Bed and also contain hardened structures, concrete pads and other test related infrastructure. A network of paved and unpaved roads services the entire area.

PHETS is located in Socorro County 21 km south of Stallion Range Center[1] and lies on a nearly level alluvial plain in the northern Jornada del Muerto Basin. Overland flow is generally westward becoming less distinct as terrain flattens. Elevation ranges from approximately 1420 m above sea level in the vicinity of the Intermediate Test Bed to approximately 1550 m at the southern end of the site.

The Soil Survey of White Sands Missile Range, New Mexico identifies three distinct mapping units within the PHETS area (USDA, 1976). The Nickel-Tencee soil association occurs extensively throughout the eastern margins of PHETS including the southeastern edge of the Large Test Bed. It occurs mainly on alluvial fans derived from nearby mountains. Soils within this association include gravelly fine sandy loam

[1] All distances are measured to and from the Administration Area at PHETS.

(Nickel) and very gravelly loam (Tencee). The Berino-Dona Ana association is a sandy loam representing the most extensive soil mapping unit within PHETS. It is found west of the Nickel-Tencee occurrence and constitutes the remainder of the soils found in the Large Test Bed. The Yesum-Holloman association is comprised of Yesum very fine sandy loam, Holloman very fine sandy loam, and gypsum land, hummocky (USDA, 1976). The Phenomenology and Intermediate Test Beds lie completely within the Yesum-Holloman association in the northwestern portion of PHETS.

SHIST and Alt. SHIST are situated on piedmont slopes draining toward the Tularosa Basin. SHIST covers 23 ha (56 ac) in Lincoln County 23 km southeast of PHETS[1]. The site is south of Oscura Gap on the western side of the Oscura Mountains. SHIST is moderately to steeply sloping, increasing in elevation to the east. Overland drainage is to the southwest. Elevation is approximately 1524 m above sea level. SHIST is part of the Rock land, cool mapping unit (USDA, 1976). Included in this unit are granite bedrock exposures, stony land, and shallow soils interspersed between rock outcrops.

Alt. SHIST covers 7 ha (17 ac) in the northern part of the San Andres Mountains of Sierra County approximately 26 km southeast of PHETS[1]. At an elevation of approximately 1463 m above sea level, Alt. SHIST is gently sloping, and drains to the northeast. The soil mapping unit for Alt. SHIST is designated Rock land, warm (USDA, 1976). Soils are thin and stony, and occur in patches atop the underlying granite bedrock.

VEGETATION DESCRIPTION

General vegetation types for the PHETS area were classified using remote sensing data collected by the New Mexico Natural Heritage Program (NMNHP). A total of eight vegetation types based on this classification were identified within the PHETS boundaries. The data, classification scheme, and associated methodology are described in *The Vegetation of White Sands Missile Range Volume II* (Muldavin, 1998). Because of their small sizes, SHIST and Alt. SHIST Sites could not be classified using the NMNHP definitions, as the scale of the remote sensing data was too coarse. Instead, they were classified by Walcoff personnel on-site using primary vegetation as the defining characteristic. Table 1 contains a summary of the vegetation types, approximate size, and primary species composition of vegetation types expected at PHETS, SHIST and Alt. SHIST. Following Table 1 is a brief description of the communities occurring at these sites.

Table 1. General Vegetation Types at PHETS, SHIST, and Alternate SHIST

Vegetation Type	**Size**		**% of Site**	**Primary Species Composition[3]**
	Ha	Ac		
PHETS[1]				
Mixed Lowland Desert Scrub	2709	6693	29.7	creosotebush, tarbush, fourwing saltbush, alkali sacaton, bush muhly
Lowland Basin Grassland	2073	5123	21.1	alkali sacaton, tobosagrass, mesquite, fourwing saltbush
Sandsage Shrubland	1257	3106	13.8	sand sagebrush, black grama
Vegetated Gypsum Outcrop	950	2348	10.5	gyp dropseed, hairy coldenia
Military Disturbance and Roads	806	1993	8.7	three-awn grasses, fluffgrass, silver-leaf nightshade

Vegetation Type	Size		% of Site	Primary Species Composition[3]
	Ha	Ac		
Creosotebush Shrubland	690	1706	7.6	creosote, alkali sacaton, bush muhly, black grama, fluffgrass
Desert Plains Grassland	463	1145	5.2	black grama, mesa dropseed, soaptree yucca, torrey jointfir
Mesquite Shrubland	119	294	1.4	honey mesquite, mesa dropseed
SHIST[2]				
Mixed Creosotebush – Mesquite Shrubland	16	40	71	creosote, mesquite, fluffgrass, ring muhly, various cactus spp on upland slope
Military Disturbance and Roads	8	16	29	three-awn grasses, fluffgrass, silver-leaf nightshade
Alt SHIST[2]				
Black Grama Grassland	3	8	47	black grama, sideoats grama, soaptree yucca, sand sagebrush
Riparian Areas	1	2	12	Apache plume
Military Disturbance and Roads	3	7	41	three-awn grasses, fluffgrass, silver-leaf nightshade

[1] data from New Mexico Natural Heritage Program
[2] data from Walcoff field personnel
[3] common names correspond to scientific names given in vegetation descriptions below

PHETS

Mixed Lowland Desert Scrub. The most common vegetation type at PHETS is a Mixed Lowland Desert Scrub community. This vegetation type dominates the eastern half of the PHETS area and is characterized by inter-mixed creosotebush (*Larrea tridentata*), tarbush (*Flourensia cernua*), and fourwing saltbush (*Atriplex canescens*). Common grasses include alkali sacaton (*Sporobolus airoides*), bush muhly (*Muhlenbergia porteri*), and tobosa grass (*Pleuraphis mutica*). Interspersed within this community are inclusions of Creosote and Mesquite Shrublands where these species occur in large enough quantities to be dominant.

Lowland Basin Grassland. The Lowland Basin Grassland vegetation type occurs on alluvial flats and basin bottoms. This vegetation type dominates the western boundary of PHETS and is scattered throughout the entire PHETS area. Characteristic plant species associated with this vegetation type include, alkali sacaton, tobosa grass, and honey mesquite (*Prosopis glandulosa*).

Sandsage Shrubland. Sandsage Shrubland is part of a larger vegetation type, Plain-Mesa Sandscrub, generally found on rolling sandy plains. It is dominated by sand sagebrush (*Artemisia filifolia*) and mesa dropseed (*S. flexuosus*). This vegetation type occurs in large tracts mainly in the northwestern portion of the PHETS area.

Vegetated Gypsum Outcrop. Vegetated Gypsum Outcrop is a unique vegetation community dominated by plant species tolerant of relatively high levels of soil salinity. Mounds and outcrops characterized by gyp dropseed (*S. nealleyi*) and hairy coldenia (*Tiquilia hispidissima*) communities are found on lowland gypsum soils in basins and foothills. Swales between mounds often contain alkali sacaton and fourwing saltbush. In this area it is associated only with the Yesum-Holloman soil map unit and is found primarily in the northwestern portion of PHETS and in small isolated patches throughout the PHETS area.

Military Disturbance and Roads. Within the three test beds are areas that are frequently disturbed and areas that have been heavily impacted by historic testing activity. These exhibit different floral characteristics compared to surrounding natural communities. The southern portion of the Large Test Bed has the largest single area of Military Disturbance which is dominated by common colonizing species including annual and perennial grasses such as three-awn species (*Aristida* spp.), fluffgrass (*Dasyochloa pulchella,*) six-weeks grama (*Bouteloua barbata*), and needle grama (*B. aristidoides*). Snakeweed (*Gutierrezia sarothrae*), silver-leaf nightshade (*Solanum elaeagnifolium*), plains hiddenflower (*Cryptantha crassisepala*), globemallows (*Sphaeralcea* spp.), Russian thistle (*Salsola tragus*), annual ragweed (*Ambrosia* spp.), and various Brassicaceae species are common.

Roads occupy more than six percent of the total land area at PHETS, including portions of RR 13 and RR 7 acting as the eastern and western boundaries. The network of roads throughout PHETS is concentrated in the three test beds . In addition to Military Disturbance which has unique vegetative characteristics, these roads are bare or mostly bare of vegetation.

Creosotebush Shrubland. Creosotebush Shrublands occur in areas where creosote is dominant enough to be differentiated by remote sensing from the Mixed Lowland Desert Scrub described earlier. It shares many of the same species components as the larger unit and occurs predominantly in the eastern and southern parts of PHETS.

Desert Plains Grassland. Desert Plains Grassland is dominated by black grama (*B. eriopoda*), soaptree yucca (*Yucca elata*), galleta (*Pleuraphis jamesii*), and Torrey's jointfir (*Ephedra torreyana*). The northern portion of the Large Test Bed contains the only substantial inclusion of Desert Plains Grassland found at PHETS.

Mesquite Shrubland. The smallest vegetation community identified in the PHETS area is Mesquite Shrubland. Like the Mixed Lowland Desert Scrub and other types of shrubland found at PHETS, this community is part of the larger Chihuahuan Desert Scrub unit. It occurs in very small isolated patches mostly in the southern part of the site which is a mixed mosaic of vegetation types. The dominant shrub is mesquite with less amounts of fourwing saltbush, mariola (*Parthenium incanum*), snakeweed, and *Sporobolus* grass species.

SHIST

Mixed Creosotebush-Mesquite Shrubland. Undisturbed areas at SHIST are dominated by mixed creosotebush-mesquite shrubland with sparse grass and cactus species on the eastern slopes. The remainder of SHIST Site is classified as Military Disturbance and populated by disturbance species as described above.

ALT. SHIST

Black Grama Grassland. Alt. SHIST is mostly Military Disturbance with remnants of black grama grassland. Small arroyos running along the eastern and western edges of the site are dominated by apache plume (*Fallugia paradoxa*) and contain other riparian species common to WSMR.

PREVIOUS SURVEY EFFORTS

PHETS

The Phenomenology, Intermediate and Large Test Beds were surveyed in the summer of 1994 in support of the *Addendum to the Environmental Assessment of Long-term High Explosive Testing at White Sands Missile Range* (Professional Systems Analysis, 1995). The purpose of this survey was to identify and characterize representative vegetation types and determine the presence or absence of Federal and State listed threatened, endangered, or candidate species.

Vegetation sampling efforts in the Phenomenology and Intermediate Test Beds were primarily in the Vegetated Gypsum Outcrop community. Transects in these areas yielded a total of 13 grasses, 14 forbs, 2 cacti, and 8 shrub species with a sampling intensity of 58% and 36% respectively in each test bed. The Large Test Bed was divided into grass and scrub communities. Surveys in the grasslands found 18 species of grass, 14 forbs, 7 cacti, and 9 shrubs compared to 10 grasses, 2 forbs, 3 cacti, and 11 shrubs in the scrub community. The sampling effort covered 2% of the test bed area. Three grama grass cactus (*Pediocactus papyracanthus*) were observed. In 1994 at the time this survey was conducted, this was listed as a Federal candidate species and a State endangered cactus. This species has since been removed from Federal and State listing and is no longer afforded protection under the Endangered Species Act or Army Regulation 200-2, however because of its prior listing it remains a WSMR species of interest (SOI).

No systematic sampling of herpetofauna or mammals took place as part of this inventory although some of both taxa were incidentally observed. Birds were sampled along a 3 km route in the Phenomenology and Intermediate Test Beds and an 8 km route in the Large Test Bed. A total of 21 species were detected. No listed bird species were observed, however two of the species seen in 1994 have since been reclassified. The burrowing owl (*Athene cunicularia*) and the loggerhead shrike (*Lanius ludovicianus*) are now considered a species of concern. Evidence of a possible active colony of black-tailed prairie dogs (*Cynomys ludovicianus*), a Federal candidate species, was observed in the western quarter of the Intermediate Test Bed. Twelve active burrow entrances were found, however no prairie dogs were observed.

An additional source of data for the PHETS area comes from the WSMR Integrated Training Area Management (ITAM) Program (U.S. Army, 1998). One of the components of the ITAM Program is the long-term monitoring of biological resources using Land Condition Trend Analysis (LCTA) data plots. A total of 27 vegetation sampling plots have been established in the PHETS area. The majority of these are special use plots clustered in the Intermediate and Large Test Beds. Two additional plots are located near the PHETS administration complex and one northwest of Trinity Site.

Beyond presence/absence of species LCTA provides information that can be used to assess individual plant mortality and recruitment of new plants. Data is available for most of the plots from 1989-1994.

SHIST

A previous survey of the SHIST area was conducted in the summer of 1993 in support of the *Environmental Assessment for the Seismic Hardrock In Situ Source Test* (Professional Analysis Incorporated, 1993). Two vegetation communities were surveyed, an ocotillo/mixed shrub desert scrub association and a mesquite/creosotebush/tarbush desert scrub association. A plant inventory of the area listed 5 grasses, 3 forbs, 6 succulents (including yucca and cacti), and 10 shrubs in the ocotillo/mixed shrub desert scrub community and 4 grasses, 5 succulents, and 9 species of shrubs in the mesquite/creosotebush/tarbush desert scrub association.

ALT. SHIST

No previous biological data is available for the Alt. SHIST Site.

METHODOLOGY

FLORA

In the present survey, floral inventories were developed from pedestrian surveys conducted at each of the three sites. Incidental observations were also recorded during various visits to the sites for other purposes. Before sampling, test beds were analyzed using soil maps, Integrated Training Area Management (ITAM) transect data, as well as maps and data produced by NMNHP to determine vegetation types. For ease of sampling, the vegetation communities derived from NMNHP data were simplified and grouped into Grassland, Shrubland/Mixed Scrub, Vegetated Gypsum Outcrop, and Military Disturbance. Surveys were conducted in three of the four major vegetation types. Areas of Military Disturbance were not sampled as part of this effort. Survey efforts were concentrated in areas where construction activities will occur at PHETS and SHIST, and in areas not previously surveyed.

PHETS. Presence/absence surveys were conducted on June 5, 2001 by Walcoff Technologies personnel: B. Wilson, J. Mosley, M. Zeisset, and K. Garber. Two transects were located on the site of the proposed landfill expansion in the Large Test Bed at PHETS. Additional survey efforts at PHETS were stratified by vegetation community within test beds. Eight transects of various lengths were located in grassland communities in the Large Test Bed. Six of these were located in the northern portion of the Large Test Bed. Four transects were also placed in Shrubland/Mixed Scrub in the Large Test Bed. Two of these were located in the proposed landfill expansion area (as mentioned above) and two transects were located in the northeast corner of the Large Test Bed. Two transects were placed in the Vegetated Gypsum Outcrop community found in and around the Intermediate Test Bed. The Phenomenology Test Bed was not sampled because the majority of it is characterized by Military Disturbance.

SHIST. A presence/absence vegetation survey of SHIST Site, proposed expansion area, and surrounding vicinity was conducted by Walcoff Technologies personnel, J. Worley on May 25, 2001. A single transect was located across the proposed expansion area, west to the entrance of SHIST Site.

Alt. SHIST. A presence/absence vegetation survey was conducted at Alt. SHIST Site on September 18, 2000 following the previously described sampling methods. A comprehensive plant species list was compiled by Walcoff Technologies personnel B. Wilson, G. Michaud, and J. Worley.

FAUNA

A baseline inventory was conducted at PHETS, SHIST, and Alt. SHIST sites for faunal species. Surveys were conducted to determine presence/absence of species, to develop a baseline inventory of fauna, and to identify any TES species. Additionally, specific surveys were conducted in the proposed expansion areas of the PHETS landfill and the SHIST site. Three primary taxa were targeted for sampling: herpetofauna, birds, and mammals including both small mammals, and megafauna. Representative vegetation associations were identified for survey efforts at PHETS, SHIST, and Alt. SHIST.

Herpetofauna. Walcoff technologies personnel J. Worely, J. Kipp, J. Mills, and M. Phillips emplaced herpetofauna traps for three consecutive days, May 15-17, 2001. Sampling was conducted May 18 and May 21-25, 2001 prior to the monsoon season. Herpetofauna were surveyed using pitfall trapping, road cruising, and active daytime searches. Surveys using pitfall traps were used in association with 30.5 m (100ft) x .61m (2ft) sections of tin flashing, constituting drift fence arrays (Figure 2). Two plastic 5 gallon buckets were used for pitfall traps at the end of each drift fence. Cover boards made from plywood were used to protect captured animals from direct exposure to the sun. Trapping at the PHETS area was divided between arrays placed north and south of Range Road 20 between the ANFO plant and Trinity Site with one array located north of Trinity and arrays located east and west of Range Road 13 in the Large Test Bed. One array each was placed at SHIST and Alt. SHIST.

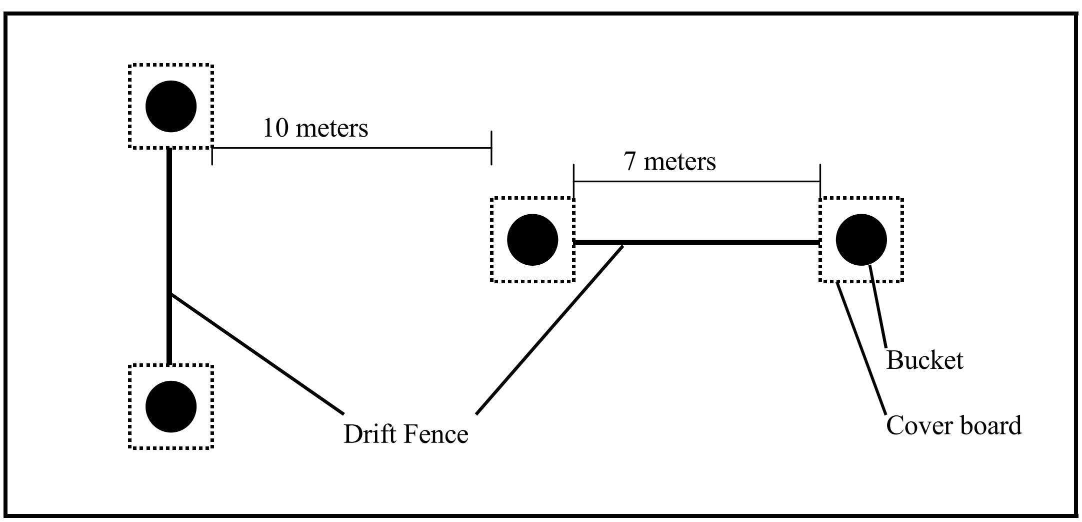

Figure 2. Representative pitfall configuration used for herpetological sampling.

Road cruising was conducted by driving on smooth surfaced roads at speeds conducive to detecting snakes (25-35 mph). These surveys were done while traveling to and from sites for other surveys. Active searches were conducted by flipping available cover (rocks, logs, debris), noosing, and ocular scanning for basking reptiles. All herpetofauna encountered during searches were captured, when possible, and identified to species.

Birds. Winter bird surveys were conducted by Walcoff Technologies personnel L. Vogel and J. Worley in December and January 2000 at PHETS, SHIST, and Alt. SHIST. Spring bird surveys were conducted by J. Worley at SHIST and Alt. SHIST in April 2001. Birds were surveyed using a point count method. Survey routes were conducted along walking transects approximately 3000 m in length with 3-minute stops at 100 meter intervals. Birds were identified aurally and/or visually (Bibby et al., 1992).

Small mammals. Small mammal surveys were conducted by Walcoff Technologies personnel J. Worley, S. Summers, and J. Mosley in April and May 2001. Trap nights were timed to coincide with the week of new moon April 23-27 and May 21-25. Sherman live traps (measuring 23 x 9 x 7.5 cm) were used to capture small mammals for identification. A total of six transects were established: four at PHETS and one each at SHIST and Alt. SHIST. Traps were opened and baited with oatmeal in the evening targeting nocturnal and crepuscular small mammal species. Traps were checked early the following morning before daytime temperatures could threaten the survival of captive mammals.

A total of 25 traps located at 10 m intervals were placed along each transect. Traps were operated for four consecutive nights constituting 600 trap nights. A trap night consists of one trap being operated for one night. Target trapping methods were adopted to sample slightly larger small mammal species. Wire traps (measuring 15 x 15 x 41 cm) were placed where signs (e.g., burrows, middens, mounds) indicated small mammal activity in areas adjacent to small mammal transects. Incidental occurrences of mammals were also recorded.

Megafauna. Megafauna presence was recorded incidentally while conducting other surveys. Active searches were conducted specifically for black-tail prairie dog (*Cynomys ludovicianus arizonensis*) occupation in the PHETS area. Sampling efforts consisted of two wildlife biologists (L. Vogel and J. Worley) intently examining the area in and around the Intermediate Test Bed where the presence of burrows was reported during 1994 survey efforts. As part of the current survey effort, approximately eight personnel hours were devoted to searching for signs of prairie dog occupation.

RESULTS AND DISCUSSION

FLORA

PHETS. As indicated by the NMNHP remote sensing data, the grassland areas of the Large Test Bed were Desert Plains Grassland. A part of this area showed some evidence of a recent fire. Vegetation was dominated by alkali sacaton mixed with burro grass and three-awn grass species. Soaptree yucca was sparse throughout the area; in many cases regrowth was occurring from charred stumps. Further west where fire influence was not an issue black grama and galleta were the dominant grasses. Woolly paperflower was common, in some areas growing densely. Other forb species present did not occur in large numbers. Two transects east of Range Road 13 crossed an area of Lowland Basin Grassland community. This community was also dominated by black grama, with alkali sacaton, burro grass and three-awn grass species. There were no abundant forbs; however forb species were found occurring in larger numbers than in the Desert Plains Grassland community.

The shrubland communities at the PHETS landfill area and in the northeast corner of PHETS were very similar. Both were Mixed Lowland Desert Scrub as indicated by the NMNHP remote sensing data. Shrub, grass, forb, and succulent species were well represented. Community structure and species dominance in this community were variable depending on slope and soil texture. In general, shrubs were more abundant than grass in the areas surveyed. Tarbush and creosote were dominant shrubs and black grama, bush muhly, and alkali sacaton were the most commonly observed grasses. A substantial suite of forbs and succulents was found, as well as cryptogamic crust.

The Intermediate Test Bed is comprised primarily of Vegetated Gypsum Outcrop with Sandsage Shrubland inclusions. This area was dominated by the common gypsum outcrop species hairy coldenia (*Tiquilia hispidissima*) and gyp dropseed (*Sporobolus nealleyi*). Swales and other small areas were populated by additional grass species, sand sagebrush and four-wing saltbush. Non-quantitative visual assessment of the Intermediate Test Bed indicated that there was more Military Disturbance than predicted by the NMNHP remote sensing data. However, these data were collected prior to 1998, so it is not surprising to find more disturbance in the test bed than expected, as military tests have taken place since the data were collected.

Table 2 is a list of floral species found during survey efforts in the Large and Intermediate Test Bed at PHETS. It should be noted that sampling was conducted in early summer when soil moisture is typically low. Monsoonal weather activity in July, August, and September would be expected to promote the germination of an additional suite of annual species at these sites. Therefore, the list of species observed at PHETS is not comprehensive.

Past vegetative fieldwork has indicated that no Federal or State listed plant species occur at PHETS, and this survey concurred. However, two WSMR species of interest (SOIs) not found in the present survey have previously been found in the PHETS area. WSMR SOI's known to occur at PHETS include grama-grass cactus (*Pediocactus papyracanthus*) and pineapple cactus (*Neolloydia intertexta*), both of which have been found in the Large Test Bed (D. Anderson, WS-ES, Land Manager, pers. comm., 2001). Although not listed in Table 2, it is assumed that these species occur at PHETS.

Table 2. Floral species found in selected vegetation types at PHETS.

Family	Scientific Name	Common Name	Grassland	Shrubland \Mixed Scrub	Vegetated Gypsum Outcrop
Agavaceae	*Yucca elata*	soaptree yucca	•	•	•
Anacardiaceae	*Rhus microphylla*	little-leaf sumac		•	
Asclepiadaceae	*Asclepias brachystephana*	short crown milkweed	•		
Asteraceae	*Acourtia nana*	desert holly	•	•	
Asteraceae	*Artemisia bigelovii*	Bigelow sage		•	
Asteraceae	*Artemisia filifolia*	sand sagebrush		•	•
Asteraceae	*Bahia absinthifolia*	sageleaf bahia	•	•	
Asteraceae	*Baileya multiradiata*	desert marigold		•	
Asteraceae	*Chaetopappa ericoides*	sand aster	•	•	
Asteraceae	*Cirsium vulgare*	thisle	•	•	
Asteraceae	*Ericameria laricifolia*	turpentine bush			•
Asteraceae	*Erigeron divergens*	spreading fleabane	•	•	•
Asteraceae	*Erigeron* sp.	fleabane	•		
Asteraceae	*Flourensia cernua*	tarbush		•	
Asteraceae	*Gaillardia pinnatifida*	cutleaf blanket flower	•		
Asteraceae	*Gaillardia pulchella*	Indian blanket	•		
Asteraceae	*Gutierrezia sarothrae*	broom snakeweed	•	•	•
Asteraceae	*Gutierrezia sphaerocephala*	annual snakeweed	•	•	•
Asteraceae	*Helianthus laciniatus*	alkali sunflower			•
Asteraceae	*Machaeranthera pinnatifida*	spiny goldenweed	•	•	
Asteraceae	*Machaeranthera tanacetifolia*	tansyleaf aster	•	•	•
Asteraceae	*Parthenium incanum*	mariola		•	
Asteraceae	*Psilostrophe tagetina*	wooly paperflower	•	•	•
Asteraceae	*Thymophylla acerosa*	spiny dogweed	•	•	•
Asteraceae	*Tragopogon dubius*	yellow salsify	•		
Asteraceae	*Zinnia acerosa*	desert zinnia	•	•	
Asteraceae	*Zinnia grandiflora*	little golden zinnia		•	
Boraginaceae	*Cryptantha barbigera*	beared cryptanth		•	
Boraginaceae	*Tiquilia hispidissima*	hairy coldenia		•	•
Brassicaceae	*Descurainia* spp.	tansy mustard	•	•	•
Brassicaceae	*Dimorphocarpa wislizeni*	spectacle pod		•	•
Brassicaceae	*Erysium capitatum*	western wallflower	•	•	
Brassicaceae	*Lepidium lasiocarpum*	Wright's pepperweed	•	•	•
Brassicaceae	*Lepidium thurberi*	Wooten's peppergrass	•	•	•

Family	Scientific Name	Common Name	Grassland	Shrubland \Mixed Scrub	Vegetated Gypsum Outcrop
Brassicaceae	*Lesquerella fendleri*	Fendler bladderpod	•	•	
Cactaceae	*Echinocereus fendleri*	Fendler's hedgehog	•	•	
Cactaceae	*Opuntia clavata*	daggerthorn cholla		•	
Cactaceae	*Opuntia engelmannii*	Engelmann's prickly pear		•	
Cactaceae	*Opuntia imbricata*	tree cholla	•		
Cactaceae	*Opuntia leptocaulis*	Christmas cactus		•	
Cactaceae	*Opuntia macrocentra*	purple prickly pear	•	•	•
Cactaceae	*Opuntia phaeacantha*	prickly pear	•	•	•
Caesalpiniaceae	*Pomaria jamesii*	James holdback	•	•	•
Caesalpiniaceae	*Senna bauhinioides*	twinleaf senna	•	•	•
Chenopodiaceae	*Atriplex canescens*	fourwing saltbush		•	•
Chenopodiaceae	*Krascheninnikovia lanata*	winter fat	•		
Chenopodiaceae	*Chenopodium album*	lamb's quarters	•	•	•
Chenopodiaceae	*Salsola tragus*	Russian thistle	•	•	•
Ephedraceae	*Ephedra torreyana*	Torrey jointfir	•	•	•
Fabaceae	*Astragalus allochrous*	Wooten milkvetch	•	•	•
Fabaceae	*Astragalus mollissimus*	woolly locoweed	•		
Hydrophyllaceae	*Phacelia integrifolia*	scorpionweed	•	•	
Linaceae	*Linum* sp.	flax	•	•	
Loasaceae	*Mentzelia* sp.	stickleaf			•
Malvaceae	*Sphaeralcea* spp.	globemallow	•	•	•
Malvaceae	*Sphaeralcea angustifolia*	globemallow	•	•	
Mimosaceae	*Prosopis glandulosa*	honey mesquite	•	•	
Nyctaginaceae	*Mirabilis linearia*	narrowleaf four o'clock	•		
Onagraceae	*Gaura coccinea*	butterfly weed	•		
Onagraceae	*Gaura hexandra*	harlequin bush	•		
Plantaginaceae	*Plantago patagonica*	woolly Indian wheat	•		•
Poaceae	*Aristida purpurea*	purple threeawn	•	•	•
Poaceae	*Bothriochloa barbinodes*	cane bluestem	•		
Poaceae	*Bouteloua curtipendula*	side-oats grama		•	
Poaceae	*Bouteloua eriopoda*	black grama	•	•	•
Poaceae	*Bouteloua gracilis*	blue grama	•	•	
Poaceae	*Bouteloua hirsuta*	hairy grama	•	•	
Poaceae	*Dasyochloa pulchchella*	fluff grass	•	•	•

Family	Scientific Name	Common Name	Grassland	Shrubland \Mixed Scrub	Vegetated Gypsum Outcrop
Poaceae	*Elymus longifolius*	bottlebrush squirreltail		•	•
Poaceae	*Muhlenbergia porteri*	bush muhly		•	•
Poaceae	*Muhlenbergia torreyi*	ring muhly		•	
Poaceae	*Oryzopsis hymenoides*	Indian ricegrass			•
Poaceae	*Panicum hallii*	Hall's panicgrass	•		•
Poaceae	*Pleuraphis jamesii*	galleta	•	•	
Poaceae	*Pleuraphis mutica*	tobosa grass	•	•	•
Poaceae	*Scleropogon brevifolius*	burrograss	•	•	•
Poaceae	*Sporobolos airoides*	alkali sacaton	•	•	•
Poaceae	*Sporobolos contractus*	spike dropseed			•
Poaceae	*Sporobolos cryptandrus*	sand dropseed	•	•	
Poaceae	*Sporobolos nealleyi*	gyp dropseed		•	•
Polemoniaceae	*Ipomopsis longiflora*	blue trumpet		•	•
Polygonaceae	*Eriogonum abertianum*	Albert's wild buckwheat		•	•
Polygonaceae	*Eriogonum rotundifolium*	roundleaf buckwheat		•	
Solanaceae	*Lycium berlandieri*	wolfberry	•	•	
Solanaceae	*Solanum elaeagnifolium*	silverleaf nightshade	•	•	
Verbenaceae	*Glandularia bipinnatifida*	Dakota vervain	•		
Zygophyllaceae	*Larrea tridentata*	creosotebush	•	•	
Zygophyllaceae	*Peganum harmala*	African rue		•	

<u>SHIST</u>. The undisturbed portion of SHIST site is characterized as a mixed creosotebush and mesquite shrubland with sparse vegetation on the upper slopes of the proposed SHIST expansion area. Table 3 represents a list of the plant species observed during the survey. Several specimen of pineapple cactus (*Neolloydia intertexta*), a WSMR species of interest, were observed on the area proposed for expansion. No other TES species or WSMR species of interest were located within the site.

Table 3. Floral species found at SHIST Site

Family	Scientific Name	Common Name
Agavaceae	*Yucca baccata*	banana yucca
Agavaceae	*Yucca elata*	soaptree yucca
Anacardiaceae	*Rhus microphylla*	little leaf sumac
Asteraceae	*Acourtia nana*	desert holly
Asteraceae	*Baileya multiradiata*	desert marigold
Asteraceae	*Chaetopappa ericoides*	white aster
Asteraceae	*Gutierrezia sarothrae*	snakeweed
Asteraceae	*Flourensia cernua*	tarbush

Family	Scientific Name	Common Name
Asteraceae	*Machaeranthera pinnatifida*	spiny goldenweed
Asteraceae	*Parthenium incanum*	mariola
Asteraceae	*Thymophylla acerosa*	American pricklyleaf
Asteraceae	*Thelesperma megapotamicum*	greenthread
Boraginaceae	*Lappula occidentalis*	desert stickweed
Brassicaceae	*Descurainia* sp.	tansy mustard
Brassicaceae	*Erysimum capitatum*	western wallflower
Brassicaceae	*Lepidium lasiocarpum*	hairypod peppercress
Brassicaceae	*Lesquerella fendleri*	Fendler bladderpod
Cactaceae	*Neolloydia intertexta*	pineapple cactus
Cactaceae	*Opuntia engelmannii*	Engelmann's prickly pear
Cactaceae	*Opuntia leptocaulis*	Christmas cactus
Chenopodiaceae	*Atriplex canescens*	fourwing saltbush
Ephedraceae	*Ephedra trifurca*	Mormon tea
Fouquieriaceae	*Fouquieria splendens*	ocotillo
Hydrophyllaceae	*Phacelia caerulea*	blue scorpionweed
Lamiaceae	*Hedeoma costata*	ribbed hedeoma
Malvaceae	*Sphaeralcea* sp.	globemallow
Mimosaceae	*Prosopis glandulosa*	honey mesquite
Nyctaginaceae	*Mirabilis multiflora*	wild four o'clock
Poaceae	*Bouteloua eriopoda*	black grama
Poaceae	*Dasyochloa pulchella*	fluff grass
Poaceae	*Muhlenbergia porteri*	bush muhly
Poaceae	*Muhlenbergia torreyi*	ring muhly
Polemoniaceae	*Eriastrum diffusum*	miniature woolly star
Polemoniaceae	*Ipomopsis longiflora*	blue trumpet
Polygonaceae	*Eriogonum jamesii*	antelope sage
Polygonaceae	*Eriogonum rotundifolium*	saucer leaf buckwheat
Rosaceae	*Fallugia paradoxa*	apache plume
Solanaceae	*Chamaesaracha sordida*	dingy chamaesaracha
Zygophyllaceae	*Larrea tridentata*	creosotebush

Alt. SHIST. The undisturbed area in and around Alt. SHIST was identified as a black grama grassland with sand sagebrush (*Artemesia filifolia*) and creosotebush (*Larrea tridentata*) as dominant shrubs. Small riparian areas flanked the disturbed area on the east and west sides of the site. The remainder of the site was characterized by military disturbance and populated by disturbance species. No TES species or WSMR species of interest were located within the site. Table 4 lists the plant species observed at Alt. SHIST.

Table 4. Floral species found at the Alternate SHIST Site

Family	Scientific Name	Common Name
Agavaceae	*Yucca baccata*	banana yucca
Agavaceae	*Yucca elata*	soaptree yucca
Anacardiaceae	*Rhus microphylla*	little-leaf sumac
Asteraceae	*Artemisia filifolia*	Sand sagebrush
Asteraceae	*Baileya multiradiata*	Desert marigold
Asteraceae	*Bahia absinthifolia*	sageleaf bahia
Asteraceae	*Bahia dissecta*	ragleaf bahia
Asteraceae	*Gutierrezia sarothrae*	broom snakeweed
Asteraceae	*Parthenium incanum*	mariola
Asteraceae	*Psilostrophe tagetina*	wooly paperflower
Asteraceae	*Senecio flaccidus*	threadleaf groundsel
Asteraceae	*Thelesperma megapotamicum*	greenthread
Asteraceae	*Thymophylla acerosa*	spiny dogweed
Boraginaceae	*Cryptantha cinerea*	James hiddenflower
Cactaceae	*Ehinocereus coccineus*	strawberry hedgehog cactus
Cactaceae	*Opuntia imbricata*	tree cholla
Cactaceae	*Opuntia leptocaulis*	Christmas cactus
Cactaceae	*Opuntia phaeacantha*	prickly pear
Caesalpiniaceae	*Senna bauhinioides*	twinleaf senna
Capparaceae	*Polanisia uniglandulosa*	clammyweed
Chenopodiaceae	*Salsola tragus*	Russian thistle
Commelinaceae	*Tradescantia wrightii*	Wright's spiderwort
Euphorbiaceae	*Euphorbia* sp.	spurge
Loasaceae	*Mentzelia albicaulis*	whitestem stickleaf
Poaceae	*Aristida* sp.	three awn grass
Poaceae	*Aristida ternipes*	spidergrass
Poaceae	*Bouteloua barbata*	six-weeks grama
Poaceae	*Bouteloua curtipendula*	side-oats grama
Poaceae	*Bouteloua eriopoda*	black grama
Poaceae	*Bouteloua hirsuta*	hairy grama
Poaceae	*Dasyochloa pulchella*	fluffgrass
Poaceae	*Digitaria californica*	Arizona cottontop
Poaceae	*Muhlenbergia porteri*	bush muhly
Poaceae	*Panicum hallii*	Hall's panicgrass
Polygonaceae	*Eriogonum wrightii*	Wright's buckwheat
Portulacaceae	*Portulaca oleracea*	purslane

Family	Scientific Name	Common Name
Rosaceae	*Fallugia paradoxa*	Apache plume
Solanaceae	*Solanum elaeagnifolium*	silverleaf nightshade
Zygophyllaceae	*Larrea tridentata*	creosotebush
Zygophyllaceae	*Tribulus terrestris*	puncture vine

FAUNA

Herpetofauna. Survey efforts at PHETS yielded 20 individual reptile captures from six genera, with a total of 12 species. Four reptile species were snakes and eight were lizards (see Table 5). All 12 species were common or expected in the habitat in which they were found. The Chihuahuan spotted whiptail (*Cnemidophorus exanguis*) was the most common teiid lizard in both the Trinity and Large Test Bed areas of PHETS. This finding is consistent with the known habitat and life history of the Chihuahuan spotted whiptail, which occurs in the drainages from mountain ranges into the desert vegetation at lower elevations (Degenhardt et al, 1996). Other small lizards in the Phrynosomatidae family such as the side-blotched lizard (*Uta stansburiana*) and the prairie lizard (*Sceloporus undulatus*) were also noted in both the Trinity and Large Test Bed areas as well as the Great Plains skink (*Eumeces obsoletus*). These species are typical and expected in the lower desert vegetation types found at PHETS.

SHIST Site yielded ten individual captures and eight observations from five genera (Table 5). The majority of captured reptiles were western whiptail lizards (*Cnemidopherus tigris*). The Western diamondback rattlesnake (*Crotalus atrox*) and greater earless lizard (*Cophosaurus taxanus*) were both observed on multiple occasions but not captured.

Alt. SHIST yielded nine individual captures and three observations from five genera (Table 5). Surveys at Alt. SHIST also resulted in the capture of many western whiptail (*Cnemidopherus tigris*) lizards. The presence of the western whiptail confirms the habitat in both areas as open desert shrubland (Degenhardt et al, 1996). The greater earless lizard was again observed in the area but not captured.

Table 5. Herpetofauna observed at PHETS, SHIST, and Alternate SHIST Sites.

Family	Scientific Name	Common Name	PHETS		SHIST	Alt. SHIST
			Trinity	Large Test Bed		
Colubridae	*Masticophus flagellum*	Coachwip Snake				1*
Colubridae	*Pituophus melanoleucus*	Bullsnake			2 **	
Colubridae	*Rhinocheilus lecontei*	Longnose Snake	1*			
Crotaphytidae	*Gambelia wislizenii*	Leopard Lizard				1*
Phrynosomatidae	*Cophosaurus texanus*	Greater Earless lizard			5 **	3 **
Phrynosomatidae	*Phrynosoma modestum*	Roundtail Horned Lizard	1			
Phrynosomatidae	*Sceloporus undulatus*	Prairie Lizard	1	2		

Phrynosomatidae	*Uta stansburiana*	Side-blotched Lizard	1	3	1	1
Scincidae	*Eumeces obsoletus*	Great Plains Skink	2	2		
Teiidae	*Cnemidophorus exanguis*	Chihuahuan Spotted Whiptail	3 ***	4		
Teiidae	*Cnemidophorus tigris*	Western Whiptail			7	6
Viperidae	*Crotalus atrox*	Western Diamondback Rattlesnake			3 **	

* caught by hand
** caught or observed in the area, not in the site in question
*** 1 specimen was being eaten by R. lecontei

Birds. Winter bird survey results were consistent with expectations for the habitats found at PHETS, SHIST, and Alt. SHIST. Dark-eyed juncos (*Junco hyemalis*) were found to be the most abundant species. During the winter season, dark-eyed juncos are common inhabitants of many habitats in southern New Mexico. Black-throated sparrows (*Amphispiza bilineata*) also made up a large proportion of the bird species observed. Black-throated sparrows are common year-round residents of the desert rocky slopes of southern New Mexico. Three bird-of-prey species were noted during the winter survey at PHETS, the red-tailed hawk (*Buteo jamaicensis*), northern harrier (*Circus cyaneus*), and great-horned owl (*Bubo virginianus*). Both the great-horned owl and the red-tailed hawk are year-round residents. The northern harrier is known to winter in the southern region of New Mexico, preferring the northern latitudes of North America for breeding. All species observed during the winter bird survey of PHETS, SHIST, and Alt. SHIST were consistent with expectations for the season and habitat sampled.

Spring bird surveys for SHIST and Alt. SHIST resulted in bird species consistent with habitat and season for the survey areas. The Northern mockingbird (*Mimus polyglottos*), a year-round resident, was found at both sites. Another year-round resident, the black-throated sparrow, was also found in both survey areas. The Northern mockingbird and the common night hawk (*Chordeiles minor*) were both abundant at SHIST Site. Survey efforts at SHIST and Alt. SHIST revealed no unexpected bird species for the season or habitat.

Tables 6, 7, and 8 list bird species found during survey efforts at PHETS, SHIST, and Alt. SHIST sites.

Table 6. Bird species observed at PHETS.

Family	**Scientific Name**	**Common Name**	**Number Observed**
			Winter 00
Accipitridae	*Buteo jamaicenssis*	Red-tailed Hawk	1
Accipitridae	*Circus cyaneus*	Northern Harrier	1
Alaudidae	*Eremophila alpestris*	Horned Lark	1
Emberizidae	*Amphispiza belli*	Sage Sparrow	2
Emberizidae	*Amphispiza bilineata*	Black-throated Sparrow	9
Emberizidae	*Junco hyemalis*	Dark-eyed Junco	24
Emberizidae	*Pipilo fuscus*	Canyon Towhee	1

Family	Scientific Name	Common Name	Number Observed
			Winter 00
Emberizidae	*Zonotrichia leucophrys*	White-crowned Sparrow	3
Fringillidae	*Carpodacus mexicanus*	House Finch	1
Laniidae	*Lanius ludovicianus*	Loggerhead Shrike	1
Mimidae	*Toxostoma crissale*	Crissal Thrasher	3
Muscicapidae	*Turdus migritorius*	American Robin	1
Phasianidae	*Callipepla squamata*	Scaled Quail	1
Strigidae	*Bubo virginianus*	Great-horned Owl	1
Troglodytidae	*Campylorhynchus brunneicapillus*	Cactus Wren	1

Table 7. Bird species observed in the vicinity of SHIST Site.

Family	Scientific Name	Common Name	Number Observed	
			Winter 00	Spring 01
Caprimulgidae	*Chordeiles minor*	Common Nighthawk	0	6
Cardinalidae	*Cardinalis sinuatus*	Pyrrhuloxia	0	1
Columbidae	*Zenaida macroura*	Mourning Dove	0	1
Emberizidae	*Amphispiza belli*	Sage Sparrow	2	0
Emberizidae	*Amphispiza bilineata*	Black-throated Sparrow	2	0
Emberizidae	*Spizella atrogularis*	Black-chinned Sparrow	0	2
Emberizidae	*Zonotrichia leucophrys*	White-crowned Sparrow	1	0
Emberizidae	*Icterus parisorum*	Scott's Oriole	0	1
Laniidae	*Lanius ludovicianus*	Loggerhead Shrike	0	1
Mimidae	*Mimus polyglottos*	Northern Mockingbird	0	8
Mimidae	*Toxostoma crissale*	Crissal Thrasher	2	0
Mimidae	*Toxostoma curvirostre*	Curve-billed Thrasher	0	2
Troglodytidae	*Salpinctes obsoletus*	Rock Wren	1	0

Table 8. Bird species observed in the vicinity of Alternate SHIST Site.

Family	Scientific Name	Common Name	Number Observed	
			Winter 00	Spring 01
Columbidae	*Zenaida macroura*	Mourning Dove	0	2
Emberizidae	*Aimophila ruficeps*	Rufous-crowned Sparrow	1	0
Emberizidae	*Amphispiza bilineata*	Black-throated Sparrow	0	3
Emberizidae	*Junco hyemalis*	Dark-eyed Junco	1	2
Emberizidae	*Piranga ludoviciana*	Western Tanager	0	1
Emberizidae	*Sturnella magna*	Eastern Meadowlark	2	0
Mimidae	*Mimus polyglottos*	Northern Mockingbird	0	1
Tyrannidae	*Myiarchus cinerascens*	Ash-throated Flycatcher	0	1

Mammals. Trapping and observational efforts resulted in eleven species within five families of mammals in the PHETS, SHIST, and Alt. SHIST areas (Table 9). Due to its varied microhabitats and large area, the PHETS survey area yielded the most diversity of mammals when compared to the SHIST and Alt. SHIST areas. The most common species captured was Merriam's kangaroo rat (*Dipodomys merriami*). This herteromyid species, along with the silky pocket mouse (*Perognathus flavus*) also found at PHETS, is common for the desert shrubland region of the study area. Black-tail jackrabbit (*Lepus californicus*) and desert cottontail (*Sylvilagus audubon*i) were the only leporids observed. Cricetid mammals captured during survey efforts included the southern grasshopper mouse (*Onychomys torridus*), cactus mouse (*Peromyscus eremicus*), deer mouse (*P. maniculatus*), and the hispid cotton rat (*Sigmodon hispidus*). The presence of these rodents is expected in the desert shrubland of the study areas. Pronghorn antelope, (*Antilocapra americana*), a large mammal common to desert grassland areas, were incidentally observed at PHETS in both the Large and Intermediate Test Beds.

The SHIST and Alt. SHIST areas yielded predominatly *D. merriami.* The rock pocket mouse (*Chaetodipus intermedius*), a species characteristiclly found in well-drained alluvial areas was found at SHIST Site. Oryx (*Oryx gazella*), an introduced species, was also observed.

Table 9. Mammals captured or observed at PHETS, SHIST, and Alt SHIST sites.

Family	**Scientific Name**	**Common Name**	**PHETS**		**SHIST**	**Alt SHIST**
			Trinity	**Large Test Bed**		
Antilocapridae	*Antilocapra americana*	Pronghorn Antelope**		6		
Bovidae	*Oryx gazella*	Oryx**			5	2
Cricetidae	*Onychomys torridus*	Southern Grasshopper Mouse	1			
Cricetidae	*Peromyscus eremicus*	Cactus Mouse	2			
Cricetidae	*Peromyscus maniculatus*	Deer Mouse			2	
Cricetidae	*Sigmodon hispidus*	Hispid Cotton Rat	1			
Heteromyidae	*Chaetodipus intermedius*	Rock Pocket Mouse			1	
Heteromyidae	*Dipodomys merriami*	Merriam's Kangaroo Rat	5	1	6	4
Heteromyidae	*Perognathus flavus*	Silky Pocket Mouse	2*	3*	1	
Leporidae	*Lepus californicus*	Blacktail Jackrabbit**	4	2	1	1
Leporidae	*Sylvilagus auduboni*	Desert Cottontail**	3	1	1	1

* Some specimen caught in pitfall traps
** This species was observed only

CONCLUSION

A total of 88 floral species comprising 64 genera were found during sampling efforts at PHETS. Vegetation occurring in the area is typical of other grassland, mixed scrub, and vegetated gypsum communities found on WSMR. The primary floral species observed during this survey are the same as those predicted by the NMNHP data set discussed earlier in this report. The overall list of species found at the site is similar to those found in previous surveys. Of the 88 species found, a total of 19 grasses, 45 forbs, 8 succulents (yucca and cacti), and 16 shrub species were identified.

A total of 39 species from 35 genera were found in the Mixed Creosote-Mesquite Shrubland dominating SHIST Site, including 4 grasses, 20 forbs, 5 succulents (yucca and cacti), and 10 shrub species.

A total of 38 species from 31 genera were found at Alt. SHIST, including 10 grasses, 18 forbs, 6 succulents (yucca and cacti), and 6 shrub species.

No State or federally listed floral species were observed at any of the three sites, and none were expected in these vegetation types. Two WSMR species of interest, pineapple cactus and grama grass cactus, were expected but neither was found during the current survey effort at PHETS. It is assumed that these species occur at PHETS. Pineapple cactus was observed at SHIST.

A total of 29 faunal species were either captured or observed at PHETS including 6 herpetofauna, 15 bird species, and 8 mammal species. No evidence of the black-tailed prairie dog (*Cynomys ludovicianus*) was found. Black-tailed prairie dogs, a Federal candidate species, may have had a historic presence in the area. A previous survey conducted in 1994 identified potential burrows, however these burrows were not found in surveys targeting this species conducted in the same area of the Intermediate Test Bed.

Survey efforts yielded a total of 25 faunal species captured or observed at SHIST including 5 herpetofauna, 13 bird species, and 7 mammal species. At Alt. SHIST, 17 faunal species were captured or observed including 5 herpetofauna, 8 bird species, and 4 mammal species. All fauna encountered during the surveys were consistent with vegetation types common to the area.

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APPENDIX E.

Threatened, Endangered, and Sensitive Floral and Faunal Species Known or Expected to Occur at White Sands Missile Range

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Table 1. Federal and State Listed Flora Known or Expected to Occur at White Sands Missile Range.

COMMON NAME ***(SCIENTIFIC NAME)***	**HABITAT**	**ELEVATION (ft)**	**FEDERAL STATUS[a] (10/00)**	**STATE STATUS[a] (10/00)**	**KNOWN ON WSMR**
APIACEAE - Parsley Family					
Desert parsley *Pseudocymopterus longiradiatus*	Interior chaparral, pinyon-juniper woodland; cliffs and narrow canyons	6,000-7,500		SOC	Y
APOCYNACEAE - Dogbane Family					
Fugate's bluestar *Amsonia fugatei*	Rocky soils of exposed reddish-purple conglomerate ridges with Chihuahuan desert scrub and grassland species. Known only on Chupadera Mesa, NM	4921-5905	SOC	SOC	
ASTERACEAE - Sunflower Family					
Guadalupe rabbitbrush *Chrysothamnus nauseosus* var. *texensis*	Crevices of limestone cliffs and huge boulders of canyon woodlands, less frequently in open gravel alluvium of stream beds. Guadalupe Mtns, TX	4,900-7,000	SOC	SOC	
Sacramento Mountain thistle *Cirsium vinaceum*	Tavertine springs, wet meadows, and along stream banks in mixed conifer zone of Sacramento Mtns	7,500-9,500	T	E	
Vasey bitterweed *Hymenoxys vaseyi*	Interior chaparral, pinyon-juniper woodland	4,400-5,900		SOC	Y
Sierra Blanca cliff daisy *Ionactis elegans*	Diorite substrate, in mixed conifer woodlands in Sacramento Mtns	8,000	SOC	SOC	
Gypsum scalebroom *Lepidospartum burgesii*	Top of small gypsum hills in an alkali sacaton-fourwinged saltbush grassland. Salt flats southwest of Brokeoff Mtns and east of Dell City, TX	4,000	SOC	E	
San Andres cross daisy *Perityle staurophylla* var. *homoflora*	Limestone cliffs; Interior chaparral, pinyon-juniper woodland	4,500-7,000		SOC	Y
San Andres cross daisy *Perityle staurophylla* var. *staurophylla*	Limestone cliffs and boulders in the Interior chaparral and pinyon-juniper woodlands	4,500-7,000		SOC	Y
BRASSICACEAE - Mustard Family					
Standley's whitlowgrass *Draba standleyi*	Rocky mountain slopes. Coahuila, Mexico through western TX and southern NM to southeastern Arizona. Organ Mtns	4,980-8,400	SOC	SOC	
CACTACEAE - Cactus Family					
Kuenzler's hedgehog cactus *Echinocereus fendleri* var. *kuenzleri*	Between rocks on gently sloping limestone outcrops in pinyon-juniper woodlands	5,800-6,600	E	E	
Duncan's pincushion cactus *Escobaria duncanii*	Alternating dolomite and chert of the Aleman Formation and limestone outcrops and derived soils among Chihuahuan Desert scrublands. Known only from Mud Springs Mountains northwest of T or C	3,000-5,000	SOC	E	
Organ Mountain pincushion cactus *Escobaria organensis*	Pinyon-juniper woodland, interior chaparral	7,100		E	Y

COMMON NAME *(SCIENTIFIC NAME)*	HABITAT	ELEVATION (ft)	FEDERAL STATUS[a] (10/00)	STATE STATUS[a] (10/00)	KNOWN ON WSMR
Sandberg's pincushion cactus *Escobaria sandbergii*	Chihuahuan desert scrubland, interior chaparral, pinyon-juniper woodland; limestone	5,900-7,300		SOC	Y
CACTACEAE – Cactus Family (cont)					
Sneed's pincushion cactus *Escobaria sneedii* var. *sneedii*	Rock cracks of limestone ledges in steep rugged terrain of Franklin Mtns and Bishops Cap	4,300-5,400	E	E	
Villard's pincushion cactus *Escobaria villardii*	Western slope of Sacramento Mtns; limestone	4,500-6,000	SOC	E	
Sand prickly pear *Opuntia arenaria*	Sandy dunes, flood plains, and foothills in Rio Grande corridor between Las Cruces and El Paso, in dune area in southern Luna county, and south of Juarez in Chih, Mexico	3,600-4,400	SOC	E	
Desert night-blooming cereus *Peniocereus greggii* var. *greggii*	Washes or flat, often under and supported by shrubs, southern NM	3,000-5,000	SOC	E	Y
CARYOPHYLLACEAE - Pink Family					
Plank's catchfly *Silene plankii*	Pinyon-juniper woodland; cliffs and rocky outcrops	4,400-6,500		SOC	Y
CHENOPODIACEAE – Goosefoot Family					
Sandhill goosefoot *Chenopodium cycloides*	Sand dunes of southwestern KS, southeastern CO, western TX, and NM	3,600-6,500	SOC	SOC	
CROSSOSOMATACEAE – Crossosoma Family					
Cliff brittlebrush *Apacheria chiricahuensis*	Pinyon-juniper woodland, Rocky Mountain montane conifer forest; cliffs	5,800-8,000		SOC	Y
FABACEAE - Legume Family					
Castetter's milkvetch *Astragalus castetteri*	Interior chaparral, pinyon-juniper woodland; limestone	4,900-5,900		SOC	Y
Kerr's milkvetch *Astragalus kerrii*	Pinyon-juniper woodland	5413-7546		SOC	
LAMIACEAE - Mint Family					
Mosquito plant *Agastache cana*	Pinyon-juniper woodland	5,200-6,200		SOC	Y
Mescalero pennyroyal *Hedeoma pulcherrimum*	Rocky Mountain montane conifer forest	6,900-9,000		SOC	Y
Todsen's pennyroyal *Hedeoma todsenii* (with critical habitat)	North and east facing steep slopes of gravelly gypsum bearing limestone soil in pinyon-juniper and sometimes ponderosa pine	6,500-6,600	E	E	Y

COMMON NAME *(SCIENTIFIC NAME)*	HABITAT	ELEVATION (ft)	FEDERAL STATUS[a] (10/00)	STATE STATUS[a] (10/00)	KNOWN ON WSMR
LILIACEAE - Lily Family					
Goodding's onion *Allium gooddingii*	Grassy meadows in ponderosa pine and spruce-fir forests around Sierra Blanca Peak; in Chuska Mtns and in AZ	9,400-11,000	SOC	E	
ONAGRACEAE – Evening Primrose Family					
Organ Mountain evening primrose *Oenothera organensis*	Seeps and springs in Organ Mtns	5,700-7,600	SOC	SOC	Y
POLYGALACEAE - Buckwheat Family					
Mescalero milkwort *Polygala rimulicola* var. *mescalerorum*	Limestone cliffs in San Andres Mtns	5,000	SOC	E	Y
PORTULACACEAE - Purslane Family					
Pinos Altos flameflower *Talinum humile*	Shallow mineral soils that accumulate in pockets between rhyolite boulders. Known in Pinos Altos Mtns in Gila, southern AZ and three states in Mexico	6,800	SOC		
SCROPHULARIACEAE - Figwort Family					
Alamo beardtongue *Penstemon alamosensis*	East side of San Andres Mtns, west side of Sacramento Mtns. Rocky limestone slopes of desert grassland and open pinyon-juniper woodland	4,500-6,200	SOC	SOC	Y
Scarlet tube beard-tongue *Penstemon ramosus*	Xeroriparian corridors in San Andres Mountains	4,800-6,000		SOC	Y
Organ Mountain figwort *Scrophularia laevis*	Quartz monsonite substrates in shaded, moist canyons. Known only in Organ Mtns	> 7,000	SOC	SOC	

[a] E=Endangered; T=Threatened; SOC=Species of Concern

Table 2. Flora Designated by White Sands - Environmental Services (WS-ES) as Species of Interest (not legally protected).

COMMON NAME ***Scientific Name***	**HABITAT**
ACERACEAE – Maple Family	
Big–leaf mountain maple *Acer grandidentatum*	Moist canyons
AGAVACEAE – Agave Family	
New Mexico agave *Agave neomexicana*	Alluvial fans and montane areas
Torrey yucca *Yucca torreyi*	Grassy and chaparral mesas and slopes
AMARANTHACEAE – Amaranth Family	
Shrubby honeysweet *Tidestromia suffruticosa*	Limestone and gypsum-rich gravelly soils
APIACEAE – Parsley Family	
Threadleaf Indian parsley *Aletes filifolius*	Rocky places in mountains of Trans-Pecos
APOCYNACEAE – Dogbane Family	
Long-flowered amsonia *Amsonia longiflora*	Xeroriparian corridors
Sand bluestar *Amsonia tomentosa stenophylla*	Deep sand and mesquite dunes
ASTERACEAE – Sunflower Family	
Spoonleaf rabbitbrush *Chrysothamnus spathulatus*	Pinyon-juniper woodlands and lower foothills dominated by creosotebush
Dotted gayfeather *Liatris punctata*	Calcareous woodlands
Gypsumwort *Pseudoclappia arenaria*	Restricted to gypsum bearing desert soils
Threadleaf horsebrush *Tetradymia filifolius*	Limestone or highly gypsum bearing soils, usually in pinyon-juniper woodlands
BORAGINACEAE – Borage Family	
Payson's popcorn flower *Cryptantha paysonii*	Open slopes on limestone soils
BRASSICACEAE – Mustard Family	
Fendler's rockcress *Arabis fendleri*	Rocky hillsides and rock crevices in full sun
Mustardwort *Thelypodiopsis purpusii*	Xeroriparian corridors in mountains
CACTACEAE – Cactus Family	
Sheer's pincushion cactus *Coryphantha scheeri* var. *valida*	Chihuahuan desert scrublands and Chihuahuan desert grasslands
Button cactus *Epithelantha micromeris* var. *micromeris*	Chihuahuan desert scrublands, Chihuahuan desert grasslands, and interior chaparral limestone
Barrel cactus *Ferocactus wislizenii*	Rocky, gravelly, or sandy soils in deserts or grasslands
Wright's pincushion cactus *Mammillaria wrightii*	Pinyon-juniper woodlands, plains and Great Basin grasslands, and semidesert grasslands
Pineapple cactus *Neolloydia intertexta*	Chihuahuan desert scrublands and semidesert grasslands

COMMON NAME ***Scientific Name***	**HABITAT**
Club cholla *Opuntia clavata*	Gravelly soils in Jornada del Muerto and Tularosa Basin
Pancake prickly pear *Opuntia chlorotica*	Above upper bajadas on steep slopes and granitic outcrops
Grama grass cactus *Pediocactus papyracanthus*	Chihuahuan desert grasslands, pinyon-juniper woodlands, and plains and Great Basin grasslands
Cat-claw cactus *Sclerocactus uncinatus wrightii*	Rugged rocky slopes
COMMELINACEAE – Spiderwort Family	
Wright spiderlily *Tradescantia wrightii*	Moist canyon stream banks
EPHEDRACEAE – Joint-fir Family	
Cory joint-fir *Ephedra coryi*	Rocky ridges in Oscura Mountains and Mockingbird Mountains
FABACEAE-Legume Family	
La Jolla prairie clover *Dalea scariosa*	Sandy soils in the northern Jornada del Muerto
GENTIANACEAE- Gentian Family	
Prairie gentian *Eustoma exaltatum*	Semidesert grassland, plains & Great Basin grassland; wet meadows and along streams
HYDROPHYLLACEAE-Waterleaf Family	
Purple scorpionweed *Phacelia neomexicana neomexicana*	Creosote scrublands
LILIACEAE – Lily Family	
Zephyr lily *Zephyranthes longifolia*	Bajadas in desert grassland
LAMIACEAE-Mint Family	
Supreme sage *Salvia summa*	Partial shade in canyons and on rocky slopes
LOASACEAE – Stickleaf Family	
Gypsum blazing star *Mentzelia perennis*	Gypsum deposits and limestone hills with gypsum lenses in the lower one-seed juniper vegetation type
MALVACEAE – Mallow Family	
Hot Springs globemallow *Sphaeralcea polychroma*	Jornada del Muerto Basin
PLUMBAGINACEAE – Plumbago Family	
Sea lavender *Limonium limbatum*	Saline flats and depressions in the Trans-Pecos
POACEAE (Gramineae) – Grass Family	
Mohave panicgrass *Panicum mohavense*	Northern Oscura Mountains
PORTULACACEAE-Purslane Family	
Long-stemmed flame flower *Talinum longipes*	Chihuahuan desert scrubland; limestone
RHAMNACEAE – Buckthorn Family	
Wright's mock buckhorn *Sageretia wrightii*	Oscura Mountains
ROSACEAE – Rose Family	
Desert serviceberry *Amelanchier utahensis*	Ropes Spring, western San Andres Mountains

COMMON NAME ***Scientific Name***	**HABITAT**
Desert rose *Rosa stellata mirifica*	Higher elevations in San Andres and Oscura Mountains
SCROPHULARIACEAE – Figwort Family	
New Mexico penstemon *Penstemon neomexicanus*	Mountain meadows in Oscura Mountains
STERCULIACEAE – Cacao Family	
Little-leaf ayenia *Ayenia microphylla*	Among boulders on limestone hills and slopes of arroyos in Trans-Pecos and western Edwards Plateau

Table 3. Federal and State Listed Fauna Kinown or Expected to Occur on White Sands Missile Range.

Common Name	Scientific Name	Federal Status	State Status
MAMMALS			
Desert bighorn sheep	*Ovis canadensis mexicana*		E
New Mexican meadow jumping mouse	*Zapus hudsonius luteus*		T
Organ Mtns Colorado chipmunk	*Tamias quadrivittatus australis*		T
Oscura Mtns Colorado chipmunk	*Tamias quadrivittatus oscuraensis*		T
Spotted bat	*Euderma maculatum*		T
BIRDS			
American peregrine falcon	*Falco peregrinus anatum*		T
Aplomado falcon	*Falco femoralis septentrionalis*	E	E
Arctic peregrine falcon	*Falco peregrinus tundrius*		T (S/A)
Baird's sparrow	*Ammodramus bairdii*		T
Bald eagle	*Haliaeetus leucocephalus*	T	T
Bell's vireo	*Vireo bellii*		T
Burrowing Owl	*Athene cunicularia*	SOC	
Common ground-dove	*Columbina passerina pallescens*		E
Costa's hummingbird	*Calypte costae*		T
Gray vireo	*Vireo vicinior*		T
Interior least tern	*Sterna antillarum athalassos*	E	E
Loggerhead Shrike	*Lanius ludovicianus*	SOC	
Mexican spotted owl	*Strix occidentalis lucida*	T	
Mountain plover	*Charadrius montanus*	T	
Piping plover	*Charadrius melodus circumcinctus*	T	E
Southwestern willow flycatcher	*Empidonax traillii extimus*	E	E
Varied bunting	*Passerina versicolor*		T
Whooping crane	*Grus americana*	E (XN)	E
REPTILES			
Banded rock rattlesnake	*Crotalus lepidus lepidus*		T
Texas horned lizard	*Phrynosoma cornutum*	SOC	
FISH			
White Sands pupfish	*Cyprinodon tularosa*		T

E=Endangered; T=Threatened; SOC=Species of Concern; SA=Species Threatened by Similarity; XN=Experimental Non-essential

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APPENDIX F.

Correspondence Between White Sands Missile Range and the U. S. Fish and Wildlife Service Regarding the Aplomado Falcon

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DEPARTMENT OF THE ARMY

U.S. ARMY WHITE SANDS MISSILE RANGE
WHITE SANDS MISSILE RANGE, NEW MEXICO 88002

REPLY TO
ATTENTION OF

Environmental Services Division

Ms. Jennifer Fowler-Propst, Field Supervisor
Ecological Services Division
U.S. Fish and Wildlife Service
2105 Osuna NE
Albuquerque, New Mexico 87113

Dear Ms. Fowler-Propst:

This letter addresses changes in the 1996 Aplomado Falcon Survey Program on White Sands Missile Range (WSMR) as proposed by the Directorate of Environment and Safety (DES).

Systematic efforts to monitor the federal endangered northern aplomado falcon (Falco femoralis septentrionalis) have been conducted on WSMR since 1992 after an adult bird of this species was observed near Rita Site in the lower Three Rivers drainage during June-July 1991. Confirmed sightings of a single bird were again made near Rita Site in April 1992 and then near the Stallion Gate in August 1992. The initial surveys for aplomado falcons and other raptors were undertaken in 1992 and 1993 by the U.S. Fish and Wildlife Service (USFWS) with funds from the U.S. Army. Aplomado falcon/raptor monitoring efforts were modified under the direction of the Materiel Test Directorate (MTD) and approved by your office to cover all weapons testing programs in the lower, mid and upper portions of the Range in 1994 and 1995. Since 1992, raptor surveyors have reported only two unconfirmed sightings (June and July 1994) of single aplomado falcons and both of these were made near Rita Site.

Starting this year, the DES, instead of MTD, will administer the Aplomado Falcon Survey Program with funds provided by WSMR test customers. This arrangement will provide a more direct link between survey management and DES, which ultimately must conduct listed species consultations with your office. Field work and data reporting will be performed by the DES environmental contractor according to DES and USFWS standards. Surveyors will be in possession of a federal take permit as provided under section 10(a)(1)(A) of the Endangered Species Act.

Design of 1996 Aplomado Falcon Survey Program will be based on the most current methods recommended by your office. The DES proposes to limit the geographic scope of the survey area to desert grasslands in the lower Three Rivers drainage and in the Jornada del Muerto (see enclosure), since these areas encompass most of the suitable-looking habitat on WSMR. This change would eliminate extensive coverage of marginal habitats in the lower and mid portions of the Range, and reduce overall cost of the survey by about one half. Specifically, the DES proposes one route near Rita Site and a total of six routes in the Jornada del Muerto. Survey routes would follow existing roads that traverse suitable aplomado falcon habitat, and would be a minimum of 16 kilometers in length. Previously used aplomado falcon/raptor survey routes would be incorporated into the new survey design whenever they clearly represent the best possible alternative, so that data comparisons between years could be maximized. The survey period would be from April 1-August 31, 1996, and the survey frequency would be every two weeks.

As in the past, surveyors would identify and record all raptors observed at search points that are located at 0.8 kilometer intervals along the designated routes. Surveys would be conducted from sunrise to four hours after sunrise during periods without precipitation and with wind speeds <10 mph. At each search point, the surveyor would identify and record the predominant vegetation type, all raptors, large corvids and owls, as well as their nests (active and inactive) on standardized data forms and on 1:24,000 scale U.S. Geologic Survey topographic maps. Standard procedures would be followed if an aplomado falcon is observed. The DES would report all aplomado falcon observations to the Ecological Services Field Office by the close of the following workday. A final report of survey findings would be mailed to the USFWS by October 1, 1996.

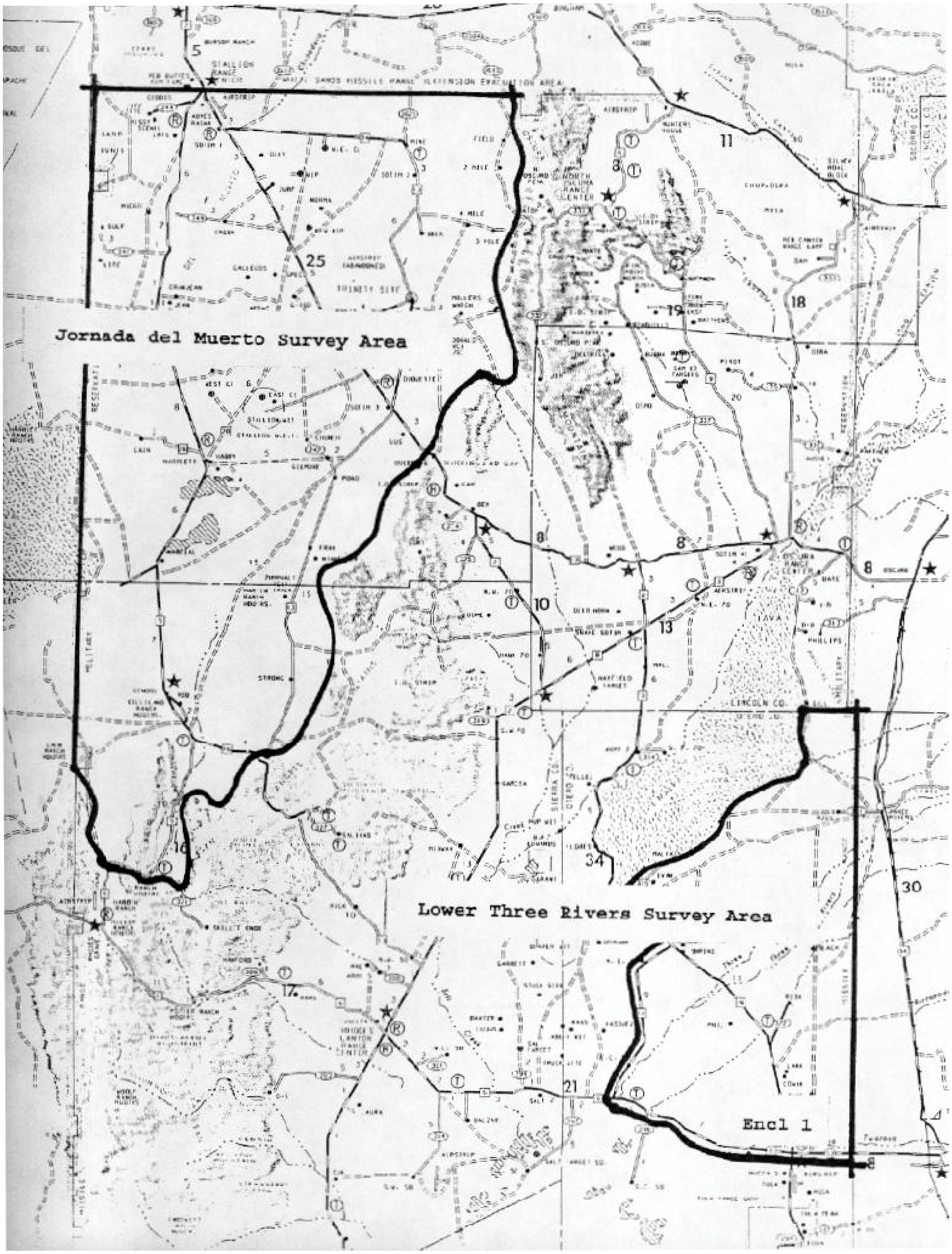
Pending approval and implementation of the proposed changes, the DES will advise proponents of test and construction actions in potentially suitable aplomado falcon habitat of the need to conduct raptor surveys on a case-by-case basis.

Comments and concurrence/nonconcurrence on the proposed 1996 Aplomado Falcon Survey Program are requested at your earliest possible convenience. The DES technical point of contact for this matter is Mr. Dave Holdermann, Wildlife Biologist, DES-E, at 678-2641/2224.

Sincerely,

Thomas A. Ladd
Director, Environment and Safety

Enclosure


Jornada del Muerto Survey Area
Lower Three Rivers Survey Area
Encl 1

05/21/96 09:41 NEW MEXICO ECO. SERV. OFFICE 002

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New Mexico Ecological Services Field Office
2105 Osuna NE
Albuquerque, New Mexico 87113
Phone: (505) 761-4525 Fax: (505) 761-4542

May 20, 1996

Cons. #2-22-96-I-249

Thomas A. Ladd, Director
Directorate of Environment and Safety
Department of the Army
U.S. Army White Sands Missile Range
White Sands Missile Range, New Mexico 88002

Dear Mr. Ladd:

This responds to your March 26, 1996, letter requesting concurrence with the proposed 1996 Aplomado Falcon Survey Program. Aplomado falcon survey efforts in 1996 for White Sands Missile Range (WSMR) will be administered by the Directorate of Environment and Safety (DES) instead of the Material Test Directorate. In 1994-1995, surveys were conducted range-wide to cover all weapons testing programs. In 1996, DES proposes to focus survey efforts in areas believed to be the most "suitable" habitat in the Jornada del Muerto (north range) and in the lower Three Rivers drainage (Rita Site) where individual aplomados were observed in 1991 (confirmed), 1992 (confirmed), and possibly 1994 (unconfirmed). Surveys will be conducted in accordance with the most current aplomado falcon survey protocol and all surveyors will be permitted by the U.S. Fish and Wildlife Service (Service) to conduct endangered aplomado falcon surveys.

The Service has reviewed your request and concurs with the proposed survey efforts for 1996. The Service recommends that at the completion of the 1996 survey efforts, DES produce a summary report of all survey efforts to date. This summary should include a listing of all surveys, habitats surveyed, and the results of all survey efforts to date. Once this information has been evaluated, representatives from DES should coordinate with the Service to determine future aplomado falcon survey and recovery efforts.

In the event that an aplomado falcon is incidentally located (not as a result of survey efforts), the Service recommends that a DES biologist monitor the individual and establish conservation measures to provide protection from ongoing and proposed actions.

Thomas A. Ladd, Director 2

In future communication with the Service on this action, refer to consultation #2-22-96-I-249. If we can be of further assistance, please contact David Leal at (505) 761-4525.

Sincerely,

Jennifer Fowler-Propst
Field Supervisor

cc:
Director, New Mexico Department of Game and Fish, Santa Fe, New Mexico
Geographic Manager, New Mexico Ecosystems, U.S. Fish and Wildlife Service, Albuquerque, New Mexico

STEWS-NRES 10 JUN 1996

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Implementation of the CY96 Aplomado Falcon Survey Program

1. Reference:

a. Memorandum, STEWS-DES, 23 Feb 96, subject: Proposed CY96 Aplomado Falcon Survey Program.

b. Memorandum, STEWS-IDD-TG, 5 Mar 96, subject: Response to the Proposed CY96 Aplomado Falcon Survey Program.

c. Memorandum, STEWS-IM-M, 4 Mar 96, subject: Response to the Proposed CY96 Aplomado Falcon Survey Program.

d. Memorandum, STEWS-DPW-C, 8 Mar 96, subject: Response to the Proposed CY96 Aplomado Falcon Survey Program.

e. Memorandum, STEWS MTD-PM, 6 Mar 96, subject: Response to the Proposed CY96 Aplomado Falcon Survey Program.

f. Memorandum, STEWS-NRO-B, 11 Mar 96, subject: Response to the Proposed CY96 Aplomado Falcon Survey Program.

g. Memorandum, NAWCWPNS-WS, 14 Mar 96, subject: Response to the Proposed CY96 Aplomado Falcon Survey Program.

h. Letter, STEWS-DES, 27 Mar 96, subject: Initiation of Consultation #2-22-96-1-249 with the U.S. Fish and Wildlife Service (USFWS), New Mexico Ecological Services Field Office (NMESFO), Proposed Changes in the CY96 Aplomado Falcon Survey Program.

i. Letter, USFWS, NMESFO, 20 May 96, subject: Summation of Consultation #2-22-96-1-249, Proposed Changes in the CY96 Aplomado Falcon Survey Program.

2. Recent evaluation by NRES of WSMR's aplomado falcon conservation program lead to proposed changes in the administration and geographic scope of programmatic falcon surveys for 1996 (ref 1a). These changes were first reviewed and endorsed by directorates and test proponents (ref 1b-g) and then approved through consultation by the NMESFO in accordance with the Endangered Species Act (ESA) (ref 1h and i).

3. The purpose of this memorandum is to provide an update to testers and other range users on the implementation of the CY96 Aplomado Falcon Survey Program.

STEWS-NRES
SUBJECT: Implementation of the CY96 Aplomado Falcon Survey Program

4. Effective 17 Jun 96 the NRES will assume responsibility for administration of the Range's aplomado falcon survey program. This arrangement will provide for a more direct link between survey management and the NRES, which ultimately must conduct listed species consultations with the NMESFO.

5. Survey field work and initial data management will be performed by the NRES environmental contractor in full coordination with NRES-E. Aplomado falcon surveys will be performed semimonthly along one route near Rita Site and six routes in the Jornada del Muerto (i.e., northwestern portion of the Range) between 17 Jun and 30 Aug 96.

6. As agreed (ref 1b-g), costs directly associated with conduct of the survey will be supported by test customers operating in either of the two areas of potentially suitable aplomado falcon habitat at WSMR (ref 1h and i). Procedures to transfer funds for cost support will be provided under separate guidance.

7. The areas of potentially suitable aplomado falcon habitat are a 20-kilometer radius surrounding the Rita Site in the lower Three Rivers drainage, and portions of the Jornada del Muerto basin below 1,800 meters elevation that lie within WSMR.

8. With respect to ESA requirements (ref 1i), all test programs and other land-use activities operating in these areas during CY96 will be covered under the NRES Aplomado Falcon Survey Program. Programs and activities that occur entirely outside these areas during CY96 will not require aplomado falcon surveys, unless specifically obligated to do so by environmental documentation that predates May 96.

9. Questions regarding this update or other aplomado falcon issues on WSMR should be directed to the NRES-E POC, Mr. D. Holdermann, at 678-2641/2224.

FOR THE COMMANDER:

Thomas A. Ladd
THOMAS A. LADD
Director, Environment and Safety

DISTRIBUTION:
D,F,G

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APPENDIX G.

Statistical Methods for Comparison of Vegetation at PHETS to Undisturbed Vegetation

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In order to determine if testing at PHETS affects vegetation, change in plant density at PHETS was compared to similar but undisturbed sites (CONTROL). In particular, tests using chemical simulants are of concern. Change in plant density was analyzed from 1994 to 1995, immediately prior to the use of tests employing chemical simulants, and from 1995 to 1997, during which tests employing chemical simulants were conducted. Because there were large gaps in the data set, these were the only data available for analysis.

Plant density is the number of individual plants per unit area. Change in plant density is a measure of both plant recruitment and plant death. It is calculated by subtracting plant density at a particular time from plant density at some later time. If change in plant density equals zero, then there was no change in plant density between the two times. This means that the rate of plant recruitment equaled the rate of death during that period of time. If change in plant density is negative, then more plants died than were recruited during that period of time; conversely, if change in plant density is positive, then rate of recruitment was greater than rate of death during that period of time.

Plant density was measured in LCTA data collection plots at PHETS and other areas on WSMR by The Nature Conservancy as a part of the ITAM project (Houde Nethers, 2001). Detailed methods of data collection are described in Tazik et al. (1992). In brief, the number of perennial shrubs and succulents were counted in a 100m x 6m strip transect at each plot. Density for each plot was then calculated by dividing the number of plants in each transect by 600 m^2. Change in plant density prior to chemical simulant testing was calculated by subtracting density at each plot in 1994 from density in 1995. Similarly, change in plant density after chemical simulant testing was calculated by subtracting density at each plot in 1995 from density in 1997.

There were 16 plots measured at PHETS, all of which occurred within 5 km of the impact site, the area most affected by tests involving chemical simulants (FCDSWA, 1998). These included LCTA "core" plots 46 and 48, and LCTA "special use" plots 338, 746, 843-847, 849-853 and 855. Plot 503, although not within the boundary of PHETS, was also included, as it was within 5 km of the impact site and in the direction of plume movement. Six relatively undisturbed LCTA plots were selected as CONTROL plots (LCTA core plots 88, 89, 90, 170 and LCTA special use plots 325, 496). These plots were selected for the CONTROL group as vegetation at these plots is similar to the PHETS plots, they are close to PHETS yet outside of a 5 km radius of the impact site, and are not in the direction of plume movement. All 22 plots were used in the pre-chemical simulant analysis. Due to missing data, a subset of plots used in pre-chemical simulant analysis were included in post-chemical simulant analysis (12 PHETS plots and two CONTROL plots). SAS (SAS Institute, 1995) was used for analyses.

A one-way analysis of variance was conducted in order to determine if there was a difference in change in plant density at PHETS compared to the CONTROL.

Between 1994 and 1995, there was no difference in change in plant density between PHETS and the CONTROL (df = 20; F = 0.62; p = 0.44); however, there was a statistically significant difference between PHETS and the CONTROL between 1995 and 1997 (df = 12; F = 15.88; p = 0.0018).

The results of the analyses of variance indicate that there was no change in plant density at PHETS or for CONTROL plots between 1994 and 1995, as means were very close to zero (Table 1) and the analysis of variance test was not significant. This implies that rates of plant recruitment were equal to rates of death during this time at both sites. The statistical difference between change in plant density at PHETS compared to the CONTROL between 1995 and 1997 is not cause for alarm. The mean (Table 1) indicates that there was no change in plant density at PHETS during this time (the mean was very close to zero); the mean for CONTROL indicates that plant density decreased in the CONTROL plots between 1995 and 1997, suggesting that there were more plant deaths than recruited seedlings for CONTROL plots. This indicates that plants at PHETS did better overall compared to plants in CONTROL plots. This may or may not be an effect of testing at PHETS, but it can be concluded that testing to date has not negatively impacted vegetation at PHETS.

Appendix G, Table 1. Least-squares (LS) means and standard errors (SE) of change in plant density at PHETS and CONTROL sites.

Site	1994-1995		1995-1997	
	LS mean	SE	LS mean	SE
PHETS	0.00202	0.0202	0.0086	0.0120
CONTROL	0.0325	0.0329	-0.1175	0.0293

References

SAS Institute. 1995. Statistical Analysis Software. SAS Institute, Cary, North Carolina.

Tazik, D.J., S.D. Warren, V.E. Diersing, R.B. Shaw, R.J. Brozka, C.F. Bagley, and W.R. Whitworth. 1992. *U.S. Army Land Condition-Trend Analysis (LCTA) Plot Inventory Field Methods.* U.S. Army Construction Engineering Research Laboratory Technical Report N-92/03. U.S. Army Engineering and Housing Support Center, Fort Belvoir, VA.

APPENDIX H.

Distribution List, Comments, and Responses

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Minutes of Scoping Meeting for DTRA Environmental Assessments
Kirtland Air Force Base, New Mexico
29 March 2001

Attendees:

COL Randy Galles	**DTRA/TDT**	**846-5513**	**randy.galles@ao.dtra.mil**
MAJ Jeffrey Fraher	**DTRA/CPTS**	**846-6991**	**jeff.fraher@ao.dtra.mil**
John Esterl	**DTRA/CSTAL**	**846-5422**	**john.esterl@ao.dtra.mil**
Lindy Ford	**WSMR MRO-CP**	**678-1082**	**fordlr@wsmr.army.mil**
John Mills	**NewTec/Walcoff**	**678-2695**	**millsj@newtec.wsmr.army.mil**
John Kipp	**NewTec/Walcoff**	**678-2936**	**kippj@newtec.wsmr.army.mil**
Kathi Bowman	**NewTec/Walcoff**	**678-1445**	**bowmank@newtec.wsmr.army.mil**
Brian Wilson	**NewTec/Walcoff**	**678-4753**	**wilsonb@newtec.wsmr.army.mil**
Jacob Worley	**NewTec/Walcoff**	**678-1776**	**worleyj@newtec.wsmr.army.mil**
Tod Stevenson	**NMG&F**	**827-7882**	**tstevenson@state.nm.us**
Mark Watson	**NMG&F**	**827-1210**	**mwatson@state.nm.us**
Elise Goldstein	**NMG&F**	**827-9927**	**egoldstein@state.nm.us**
Julie Jacobs	**NMED/GWQB**	**827-2776**	**julie_jacobs@nmenv.state.nm.us**
Cheryl Frischkorn	**NMED/HWB**	**827-1557**	**cheryl_frischkorn@nmenv.state.nm.us**
Chris Serazio	**NMED/HWB**	**827-1557**	**chris_serazio@state.nm.us**

Assisting: Yeoman Benjamin

The meeting started shortly after 1000 hrs with introductions and a welcoming statement by COL Galles. In his statement, COL Galles mentioned the need for improving environmental stewardship and furthering partnership efforts between the military and government agencies. Regarding the HTDT project, COL Galles related that portal/adit construction would be more economical at White Sands Missile Range (WSMR) than the Nevada Test Site (NTS).

A video tape on DTRA's history and testing activities at WSMR (and NTS) was then shown to the attendees. Running time was approximately 15 mins.

MAJ Fraher voiced comments about hard target defeat strategies, some upcoming tests series (e.g. DIVINE ALBATROSS), and a new Geographic Information System (GIS) to be installed soon. This commentary led into discussion of the PHETS PEA to which a number of questions were raised as follows:

- Chris Serazio wanted to know about access to northern part of the range for inspections by New Mexico Environment Department (NMED). Lindy Ford said that access was not a problem.
- Chris Serazio asked about perchlorate regarding PHETS. John Mills responded that the potential presence of this compound will be studied and, if pertinent, will be included on the assay list.
- Mark Watson asked about the triethyl phosphate plumes and their impact on pupfish habitat, and how protection of this habitat can be assured. John Mills and

John Kipp answered by saying that prevailing winds, the physical barrier of the Oscura Mountains, and the overall separation distance (10-15 miles) would prevent the plume from reaching pupfish habitat. Lindy Ford reasserted the prevailing wind explanation. Mention was made of testing in this area having gone on for about nine years.

Yeoman Benjamin related some go-no go weather-related criteria such as too much wind, too cloudy to further reinforce the point that conditions are carefully considered before each test.

- Julie Jacobs asked that the PEA list the explosives and simulants used (with any associated combustion and degradation by-products) for potential impact on the ground water. Ms. Jacobs asked to receive the results of water samples. She asked where the monitoring wells were located, depth to water, and total dissolved solids. J. Kipp answered.
- Mark Watson wanted a record of plume studies to be in the PEA. He also wants to be notified if wind conditions change in the direction of the pupfish habitat during a test.
- New Mexico Department Game and Fish (NMDG&F) asked about wildlife surveys, and Walcoff personnel responded that some limited live trapping of small mammals and herpetofauna was planned in the near future.
- Chris Serazio asked about the PHETS landfill. Walcoff personnel and MAJ Fraher replied that only construction debris was allowed and that an exemption permit was being applied for from the State.

With no further questions about the PHETS PEA, the focus of discussion shifted to the HTDT project. MAJ Fraher explained that portal construction may require water blast drilling. Pads in front of the adits will consist of sharp, angular granite spoil which will likely require application of finer top course to avoid damage to tires, etc. Questions specific to HTDT are as follows:

- Julie Jacobs addressed her concern about surface water drainage at HTDT. She wanted the EA to address this. She wants to see protection afforded to ground water and mechanisms for potential pollution through San Andres recharge areas. On-site ponding to reduce runoff and sediment transport were mentioned. The fate of construction debris will be specified in the anticipated 404 permit.
- Jake Worley discussed bat detection methods to be used during surveys, and Tod Stevenson appeared to concur. John Mills mentioned that measures will be taken to ensure adits do not become habitat for bats or other wildlife.
- Elise Goldstein voiced concern about the bighorn sheep and said that a population of sheep will be released in the fall of 2001. She also said that an ewe dropped a lamb recently and wants to be sure that they will be protected. Tod Stevenson wanted to be kept informed about any the bighorn sheep developments. J. Mills mentioned having an "informal consultation" with NMDG&F at their request.

MAJ Fraher indicated that Capitol Canyon is the primary site planned for target construction and that Mockingbird South is an alternate location. He also mentioned that an Environmental Impact Statement (EIS) may eventually evolve after further analyses.

The meeting finished at approximately 1215 hrs with discussion of the number of copies of draft documents each agency would like to receive (two copies to NMDG&F, one copy to each of the NMED attendees and an extra to Greg Lewis). Mark Watson expressed a desire to visit the sites. Compliments were given by NMED and NMDG&F to DTRA for including them in the scoping process.

----Original Message-----
From: MWatson@state.nm.us [mailto:MWatson@state.nm.us]
Sent: Tuesday, April 10, 2001 2:45 PM
To: worleyj@newtec.wsmr.army.mil
Subject: bats

Jacob: Regarding the bat situation and the EAs for Hard Target etc., I discovered USFWS comments from 10 May 1995 for PHETS. In these they identify colonies of three species of bats that occur in the lava flow southwest of PHETS at Lat. 33 31' 00", Long. 106 52' 30". The lava apparently contains multiple caverns used as hibernaculum for Townsend's big-eared bats and fringer myotis; and "the area harbors a known maternity colony of Mexican free-tail bats between March and September."

Mark L.Watson
Habitat Specialist
Conservation Services Division
NM Department of Game and Fish
P.O. Box 25112
Santa Fe NM 87504
(505) 827-1210
FAX: (505) 827-7801

Response to comment:

The bat species mentioned are not afforded special protection under current Federal or State law. These species are generally referred to in section 4.2.2 Fauna, page 23 as “bats”. PHETS is approximately 22 km from the lava flow and bats may feed on insects in the area. The insects, in turn, may be affected by simulant use from collateral damage assessments (refer to section 6.2.3 Potential Effects on Biological Resources, page 52).

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Gary E. Johnson

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April 11, 2001

Major Jeffrey Fraher
Environmental Engineer
DTRA/TDTS
1680 Texas Street SE
Kirtland AFB NM 87117-5669

Re. Hard Target Defeat Testbed, Permanent High Explosive Test Site, and Bedrock Penetration Test Sites Projects

Dear Major Fraher:

The New Mexico Department of Game and Fish (Department) thanks you for the opportunity to meet with military and state agency personnel to discuss issues associated with the above referenced projects. In our 29 March 2001 meeting, we voiced our concerns regarding the potential for these projects to impacts habitats of the state-listed desert bighorn sheep (*Ovis canadensis mexicana*) and White Sands pupfish (*Cyprinodon tularosa*). We are concerned primarily with the potential for impacts from 1) mining operations and bombing on bighorn sheep in the San Andres Mountains; and 2) biological and chemical warfare agent simulant tests on White Sands pupfish.

The Defense Threat Reduction Agency proposes to test 30+ biological and chemical warfare agent simulants within 15 miles of known occupied pupfish habitat. Plumes from previous tests have been known to travel up to 30 miles. Therefore, we request 1) that Material Test Data Sheets (MTDSs) for each agent be included in an appendix within the Environmental Assessment (EA); and 2) that the EA contain a thorough analysis of the potential effects of these agents to aquatic biota in general and White Sands pupfish in particular, in the event that test material is deposited in White Sands pupfish habitat.

We would like to schedule a site visit in the near future to further discuss these issues. Once again we appreciate the opportunity to meet with you before the release of project EAs to discuss concerns. Should you have any questions regarding these comments, please contact Mark Watson, Habitat Specialist of my staff at 827-1210, or mwatson@state.nm.us.

Sincerely,

Tod W. Stevenson

Tod W. Stevenson
Chief, Conservation Services Division

Cc: Scott Brown (Assistant Director, NMGF)
Bill Hays (Conservation Services Assistant Chief, NMGF)
Pat Mathis (Southwest Area Habitat Specialist, NMGF)
Alisa Goldstein (Bighorn Sheep Biologist, NMGF)

WS-ES Comments

TITLE: Preliminary Draft Programmatic Environmental Assessment for the Permanent High Explosive Test Site and Bedrock Penetration Test Sites, White Sands Missile Range, July 10, 2001
PREPARED BY: NEWTEC/Walcoff Technologies, White Sands Missile Range, New Mexico
REVIEWED BY: Kelly Blough, WS-ES-EC; Robert Andreoli, WS-ES-EC; Karen Hay, WS-ES-C; David Anderson, WS-ES-ES; Mike Mallouf, WS-ES-ES; Patrick Morrow, WS-ES-ES

Comment # /Commenter	Page / Sect	Para / Line	Comment	Response
1/Blough	1		By the use of the term 'permanent' does this DOPA propose a change of status of status of the HE Test Site or the program?	None of the facilities associated with the site are permanent; however, the term PHETS has been used since at least the mid-1980s and testing has been performed on the testbed since the 1940's.
2/Blough	6	Table 1	Not all of the acronyms are in the acronym list	The acronyms have been added to the table.
3/Blough	7 / 2.1.3	1 / 11	Please clarify totals. The text seems contradictory with regard to the amount of chemical simulants that may be released per test and in annual total.	The totals have been clarified, the paragraph now reads, "Chemical simulants testing will be limited to a maximum of four releases per year at up to 15,142 L (4,000 gal) each or a maximum release of 60,567L (16,000 gal) per calendar year. This total includes open-air release of chemical simulants, which will be limited to 1893 L (500 gal) per open-air test. Biological simulants will be limited to four releases per calendar year with amounts not to exceed those given in Table 1, Appendix B. In total, the frequency of collateral damage tests whereby simulants and/or other test materials are released will not exceed a total of eight per year.
4/Blough	10 / 2.2.3	1 / 7	See comment 3. If the difference in totals is related to containment during the test, it needs to be clarified.	The totals confusion *was* related to containment and has been clarified.
5/Blough	10 / 2.2.3	1 / 11	What atmospheric conditions specifically and how are they factored into the test process. Is there a current SOP?	Changed to: In all instances, weather conditions must be suitable on test days (i.e., wind speed will be less than 20 knots, and wind direction is south-southwest). Specifc meteorological conditions will be pre-determined and described in each test description document. Current weather in the region will be closely monitored to reduce potential adverse effects prior to and during simulant tests. (Also refer to Section 5.2.3 Threatened and Endangered Species, *Fish* for further information).
6/Blough	11 / 2.5	1	Please discuss the regulatory status	The following was added to the

Comment # /Commenter	Page / Sect	Para / Line	Comment	Response
			of the landfill and its expansion with respect to the explosive and simulant residue and the waste stream including personal protective equipment.	paragraph, "The landfill is under application for State exemption status as a construction landfill. A groundwater monitoring well has been drilled adjacent to the landfill to ensure that no residues are entering the ground water." This is a construction landfill and as stated in the document only construction debris such as concrete, reinforcing steel, wood and masonry will be allowed in the landfill, no ppe would be disposed of there.
7/Blough	12	Table 3	Very helpful table. If possible please show in this table or a new table where this proposed action exceeds the DOPA from the previous EA.	The PEA is proposed to cover all testing; therefore, it is not necessary to differentiate the proposals that would be in excess of the original EA. These are discussed in the document text.
8/Blough	22 / 4.1.5	Surface Water	There needs to be some determination of the maximum region that could be affected by the proposed action. Section 2.1.3, paragraph 1, line 9 indicates taggants and tracers may be tracked up to 30 kilometers. Is 30 km then the maximum region that could be affected? There are many springs, wildlife watering units, stock tanks, and intermittent surface drainages within 30km of PHETS. A 30 km radius includes watersheds for the Rio Grande (give distances) and Salt Creek and significant land area beyond the WSMR boundary with unidentified surface water resources.	Tracer gases and essentially non-toxic taggants have been detected in air samplers in very small amounts up to 30 km away and will not appreciably affect surface water in the region. The chemical simulant TEP has been estimated at very low concentrations near the WSMR boundary, a distance of approx. 16 km (See Appendix C). For a discussion of the levels of chemical simulant, surface deposition, and concentration please refer to 5.5 Air Quality, page 48, para 5. For a discussion of effects in the water system please refer to 5.1.5 Water Resources.
9/Blough	22 / 4.1.5	Ground Water / Para 3	Please cite the drinking water standards and New Mexico Water Quality Control Commission Regulations (20.6.2NMAC, 15 Jan. 01) standards.	The regulations are now cited.
10/Blough	23 / 4.1.5	Figure 4	Please indicate location of 'Story Well' and groundwater elevation, gradient and trends in groundwater quality for the PHETS affected area and the two other sites.	The map has been edited to show most of the items specified. The wells nearest SHIST and Alt. SHIST now have reported TDS concentrations included.
11/Blough	32 / 4.8	1 / 6	Discuss the existing satellite accumulation point and any changes that may be needed as a result of the proposed action.	There is a pick-up area for POL waste, and section 4.8 has been updated in that regard. No hazardous waste is generated on-site, according to DTRA personnel.

Comment # /Commenter	Page / Sect	Para / Line	Comment	Response
				No changes are anticipated due to proposed action.
12/Blough	33 / 4.10.2	1 / 2	Water for the PHETS site is obtained from the Stallion Range Center water system and delivered to a storage tank at PHETS via tank truck. This water is non-potable and used for sanitary purposes. Bottled water is provided for drinking.	Entered this information into the document at 4.10.2 in place of the information that was there.
13/Blough	37 / 5.1.5	Surfa ce Water / 1 / 7	This analysis should be revisited to ensure that the original assumptions are still valid for the other proposed simulants, project footprint and duration. A discussion of the toxicological and regulatory significance of the predicted concentrations (and location) is also needed.	The analysis was revisited during the EA writing process, and a viable pathway for contamination of surface waters from airborne deposition was not found. Toxicological effects, threshold limits, and permissible exposure limits (if they exists) are presented in Appendix C.
14/Blough	37 / 5.1.5	Grou ndwat er / 1 / 2	The creation of secondary porosity due to detonations may significantly alter the hydrogeologic characteristics of the geologic materials. Is there any measurement-based estimate of this consequence?	The PHETS EA of 1987 mentions that ground motion from static detonations will not affect ground water. The present analysis recognizes a potential for increased porosity (and permeability), but no significant effect to g.w. is expected. At this writing, water samples from area monitoring wells are being analyzed for the presence of explosive residues. Otherwise, no empirical data or models have been found that addresses this situation.
15/Blough	37 / 5.1.5	Grou ndwat er / 1 / 4	Please clarify ‘few existing wells may have been subject to damage’. If suspected, has this been confirmed? The cumulative affect of the past activities combined with the proposed action has potential for significant affect. The location, construction, and integrity of ‘damaged’ wells are relevant to the analysis of consequences for this resource.	This sentence was conjecture and has been changed to: “At PHETS, most existing wells drilled for early test series have not been used for many years and are presently not serviceable for water production.” It has not been substantiated that older wells have been affected by high explosive testing.
16/Blough	38 / 5.1.5	Grou ndwat er / 2	What are the potential affects of the inert projectiles encountering shallow (perched) saturated zones. Are the projectiles recovered? There is potential for creating pathways for migration of contaminants to groundwater. The regulatory significance of these ‘transitory’ groundwater features	Paragraph was revised to read: “Inert, non-explosive projectiles are capable of penetrating the thin alluvial cover to reach bedrock at SHIST and Alt. SHIST. Minor amounts of water are surmised to temporarily accumulate in sediments atop bedrock surfaces, especially during the summer rainy

Comment # /Commenter	Page / Sect	Para / Line	Comment	Response
			should be clarified.	season. Impact and projectile recovery disturbances to this highly localized, transitory ground water will be insignificant."
17/Blough	41 / 5.2.2	2 / 5	Please address the potential for enhanced recharge, along with secondary porosity and mobile contaminants in the hydrogeologic analysis.	Refer to #14's response.
18/Blough	55 / 6.2.1	3	Sampling and analysis should be conducted in accordance with a plan that prescribes sampling locations, protocol, analytical methods and quality assurances and quality control measures to attain identified data quality objectives. With respect to multi-media compliance, there are two contaminant migration pathways that need to be analyzed. The analytical thresholds as proposed may not be protective of worker health and hydrologic pathways. In particular, the transport simulation referenced in FCDSWA 1998 does not address cumulative impact and may be outdated with respect to present understanding of subsurface materials, features and receptors. Identification of defensible exposure concentrations and back calculation through transport mechanisms may yield a more defensible soil concentration threshold.	Human hazard thresholds and potential hazards to worker health can be found in Appendix C, and in MSDS's for the chemicals. Added into the paragraph, "A detailed soil sampling plan describing locations, methods, and analytical objectives will be submitted to WS-ES prior to implementing the plan." A hydrologic pathway to ground water is unlikely given the arid to semi-arid climate and the widespread presence of caliche (or a gypsic-petrogypsic horizon) at relatively shallow depth (~3 to 5 m). Using the equivalent depth of water equation (Hanks, 1992, Applied Soil Physics) and conservative assumptions for soil texture and water content, it was estimated that over two meters of surface water would be needed to conceivably wet the underlying soil to a depth of 75 ft. (the water table depth near the Intermediate Test Bed). This further supports the idea of effective disconnection between surface and ground water in the region.
19/Blough	56 / 6.2.2	1 / 2	Downward migration of simulants may or may not be impeded. This possibility needs to be evaluated in some defensible fashion in order to determine the significance of impact.	As stated in the document (Refer to section 5.1.5 Water Resources,page 38, para 5), it is unlikely that chemical simulants dissolved in soil water would be transported deeper than the effective depth of wetting.
20/Blough	61 / 8.0		Depending on the circumstances, groundwater contamination should it occur, would be very difficult if not impossible to reverse.	This possible effect is discussed in 6.2.2 Potential Ground Water Contamination, the groundwater will be monitored and if any contamination occurs, remediation will be implemented.

Comment # /Commenter	Page / Sect	Para / Line	Comment	Response
21/Blough	Gen. Com-ment		It appears that the focus of the testing program is to study the release to the atmosphere of hazardous materials as a result of WMD target defeat activities. In practice, the release of these materials in an actual operation may significantly affect soil and hydrologic pathways. The present hydrologic analysis in this NEPA document is not sufficient to support a FONSI. Additional analysis may permit a FONSI, and provide a frame of reference for assessing hydrologic impact in an actual operation.	Soil and water sampling plans as well as monitoring of vegetation in selected plots will be implemented at PHETS. Analysis of the chem./bio simulants, taggants and tracer was conducted (see Appendix C). The concentration of test materials dissipates rapidly with distance from the test structure. Phytotoxic effects (i.e. plant wilting) may occur within approximately 400 m after larger tests but should not significantly affect the outlying region. The containment of materials in test structures (for the larger tests) and the smaller amounts allowed in open-air tests will help ensure that ground water hydrology will not be affected. This evaluation is supported by the relatively deep ground water depth (>75 ft) and presence of indurated or plugged soil horizons.
22/Andreoli	7/2.1.3		This section depicts a very confusing number of tests. The EA states that there will be no more than eight (8) tests that release simulants or chemicals per year. Then it states that there will be only four (4) releases per year or 16,000 gal, then it states that each test will use a maximum of 500 gal. Is it eight tests or four tests? If it is eight tests at 500 gal then the total is 4000 gal, and if only four tests are going to occur, then the maximum is 2000 gal. Is the total amount released 2000 gal, 4000 gal, or 16000 gal? Later in the document on page 54 the total number of tests for PHETS is 94. The document and planners need to fully understand their tests and the cumulative impacts associated with their actions. The document confuses this issue. This level of confusion was done in other documents and was a source of major criticism by the public. Please clear this up.	Please refer to responses 3 & 4. The total number of tests (94) refers to all types of tests not just the collateral damage tests referred to in Section 2.1.3.
23/Andreoli	11/2.4		This section is part of the proposed action. This section describes construction but fails to put in the	Dust control is discussed in Section 5.1.4 Geology and Soils. A reference to the section and what is

Comment # /Commenter	Page / Sect	Para / Line	Comment	Response
			use of dust control techniques as part of the proposed action. The proposed action includes a statement whereby Threatened and Endangered Species are to be avoided during construction, but contains no equivalent statement concerning dust generation during construction. This needs to be fixed.	planned has been included in the paragraph in 2.4.
24/Andreoli	40		States that a model will be used by the project for all future tests using simulants. This model must be coordinated with WS-ES-EC prior to its use to assure the information generated can be used to comply with environmental regulations.	The sentence was modified to, "All future tests using simulants will require plume models to be included as part of the U.S. Army Record of Environmental Consideration (REC) coordinated and approved by WS-ES to ensure that they comply with environmental regulations prior to testing."
25/Andreoli	48		States that dust suppressants will be used during test bed preparation. The type of dust suppressant used must be coordinated with WS-ES-EC and its use must be documented (text and pictures) to clearly demonstrate compliance with the Natural Events Action Plan, of which WSMR is a part.	A statement to this effect has been added to page 49, para 4 under 5.5 Air Quality. It reads, "Dust suppressant use will be documented in mission-specific RECs and coordinated with WS-ES-EC."
26/Andreoli	50/4.9		Includes latrine waste. This type of waste is not a regulated item as Hazardous Waste. Recommend re-titling the section or moving the verbiage to another part of the document for clarity.	The sentence was removed.
27/Andreoli	App. C		This section tends to use dissimilar units making possible toxicity to humans or the environment difficult to understand. For example in the section for Bg it is stated that inhalation toxicity to guinea pigs is greater than $2x10^6$ spores, and the expected concentration at the boundaries is above 20 to 2000 CFU, which is expected at a distance of 27 km from the PHETS area. Please explain how these units compare and what is the actual expected concentration at the closest WSMR boundary.	There is no direct conversion between some of the toxicity units; the appendix is a literature review and combines information from different articles. Where it was possible to standardize units, this was done. The expected concentration of TEP and other simulants at the boundary is estimated at 0.012 mg/m^3. (Refer to Appendix C page 7, DIMP discussion area.) *DIMP has since been removed from the EA; the referred to DIMP discussion is also located in Appendix C, page 6&7, DMMP.
28/Andreoli	App. C5		States that MS2 bacteriophage may affect the soil community at	Added to this section: MS2 bacteriophage are short-lived when

Comment # /Commenter	Page / Sect	Para / Line	Comment	Response
			PHETS, but I found nothing in the mitigations on how this problem will be mitigated.	subjected to UV light in sunlight and to desiccation. Their application to the soil surface may locally reduce the number of certain near-surface host bacteria, but the overall affect to bacterial populations in the underlying soil would not be significant (Dr. William Lindemann, soil microbiologist, NMSU, 2001[paraphrased]).
29/Andreoli	App. C6		States that the human health hazards of DEMP are not known, but the document concludes that DEMP will not have a significant impact. This final conclusion is based on insufficient evidence. Recommend that the use of chemicals or simulants that do not have sufficient information to be halted until such information is available. A supplementary NEPA document will need to be done at that time.	DEMP has been removed from the list of proposed chemical simulants under this PEA.
30/Andreoli	App C7		States the DIMP cannot be used at DPG (outdoor use) due to its potential for groundwater infiltration and long life. Why is it then OK for this item to be used at WSMR?	The persons who originally provided this information on DIMP use at Dugway Proving Ground, John Martin and Steve Klauser, have requested that questions in regard to simulants be directed to another person (Jim Wheeler, research biologist). Mr. Wheeler's response to DIMP use will be inserted as follows: "DIMP is used in outdoor tests at Dugway Proving Ground, provided that the material is well dispersed and not concentrated in a small area (Jim Wheeler, research biologist, pers. comm. 2001)". Thus, the original information attributed to Messrs. Martin and Klauser was erroneous and will be deleted. There are environmental concerns for the testing use of DIMP, and to the largely unknown human toxicity potential. However, an aggressive, well-planned soil and ground water monitoring program under this PEA will provide information on accumulation and persistence of this substance in the environment. If elevated levels are detected,

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				mitigation measures approved through WS-ES will be implemented. *DIMP has since been removed from proposed simulant use for this EA.
31/Andreoli	App C9		For the proposed item DMPP the above two comments apply (see comment for page C6 and C7).	The term "DMPP" in the comment for item 31 is assumed to be a typographical error for DMMP. The following has been added: "The U.S. Army Environmental Hygiene Agency has adopted a recommended exposure limit (REL) of 20.0 ppb of DMMP, bearing in mind that this is the highest concentration recommended for continuous human exposure. A dispersion model for TEP (assumed to be essentially similar to DMMP and other chemical simulants) predicted a plume concentration of approximately 4.0 ppb after 1-1.5 hours some 20-25 km downwind (FCDSWA, 1998). Although high concentrations at the detonation site would be expected briefly after a test, levels would dissipate rapidly after the first day." Also added: "The lowest observed adverse effect level (LOAEL) for DMMP is reported at 179 mg/kg body weight/day (Rowland et al., [no date], Health Advisory for DMMP, EPA report). A 70-kg human would have to ingest over 12,000 mg of DMMP before deleterious effects are noted. This potential exposure is not conceivable in any planned test scenario at PHETS. DMMP does have reported cargenogenic potential based on studies with rats but amounts administered were large and occurred over an extended time period (same source as above)". The Rowland et al. report will be included in a collection of Material Safety Data Sheets for Chemical and Biological Simulants, High Explosives, and Related Test

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				Materials for PHETS, to be provided to NMED (per request) and to selected libraries during the public review period.
32/Andreoli	App C9		Indicates DPM will be used. DPM is a glycol ethers and is regulated as a hazardous air pollutant. WSMR has a limit of 9.9 tons/year for this item. The amount used of this item must be reported to WS-ES-C every six months (1 Jan through 30 Jun and 1 July through 31 Dec). The amount used must be within the permit limit after it is coordinated with other range generators of this class of chemicals.	Use of this chemical will be coordinated with WS-ES-EC.
33/Hay	Exec Summ		Recommend beginning with the identification of lead and cooperating agencies. This should be done briefly, by identifying the role, organization and a short description of their responsibilities and signatory authorities (i.e. Lead Agency: Defense Threat Reduction Agency (DTRA), proponent for considered actions (approval authority); Cooperating Agencies: U.S. Army White Sands Missile range (WSMR), landowner of affected environment (approval authority); etc.) Recommend that the State Historic Preservation Office (SHPO) and the United States Fish and Wildlife Service (USFWS) (the proposed affected area falls within the Trinity Historic Area as well as in identified potential habitat of the federally endangered Northern aplomado falcon), also be considered as cooperating agencies. Agreements exist with both agencies affecting considered actions of this assessment. Question: Should the Air Force and other potential users of the considered actions be identified as cooperating agencies?	All of these agencies are discussed within the Executive Summary, with the exception of the cooperating agencies. A reference to them in this section was added. It reads, "Coordinating and reviewing agencies are listed in Appendix H in the Distribution List." DTRA is closely connected to the Air Force; therefore, they do not need to be listed separately.
34/Hay	Exec Sum.		Recommend briefly identifying the affected jurisdictions of the considered action, (i.e. WSMR, NM, the individual counties, etc., that are involved, etc. Just state	WSMR is mentioned as being the location of the testbeds; specific location of WSMR is included in Affected Environment.

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			what they are, the Affected Environment section should cover environmental descriptions of them.)	
35/Hay	Exec Sum.		Recommend briefly identifying the preparer(s) of the document (i.e. This document was prepared by New/Tec/Walcoff Technologies…, and referring to the table on page 73), those responsible for reviewing it, (an appendix in the PDEA containing correspondence from reviewers can be referenced), and those responsible for recommending approval.	The preparer of the document is indicated on the title page and as mentioned the specific collaborators are on page 73. The reviewing agencies are listed in Appendix H; please review response 33.
36/Hay	Exec Sum.		Recommend condensing pages i through iii, to a brief synopsis of the proposed action and alternatives. Recommend starting with "It has been determined that a programmatic level of assessment be performed due the broad scope and required flexibility of the proposed and alternative actions", then following with a brief (one or two lines) descriptions of the proposed action and each alternative considered and their potential effects.	This section, as an executive summary, is intended to summarize the entire document not just portions of it as a foreword or a cover sheet might.
37/Hay	1-3		Recommend removing paragraph 1.1. The purpose and need should not refer to the proposed alternative (i.e. build targets and perform simulant tests at PHETS and the SHIST sites). Also, the Purpose and Need section is not the place to discuss the affected environment (i.e., the Trinity Landmark, mountains, etc) or to determine that a PEA is needed (Executive Summary, see recommendation 4a)	Have re-organized the section by re-naming section 1.0 'Introduction' instead of 'Purpose and Need of Proposed Action' and re-naming '1.1 Overview' instead of 'Introduction' to clarify the content of the sections.
38/Hay	1-3		Recommend removing paragraph 1.2. Previous NEPA documentation is not a purpose or need. Recommend this information be moved to the Reference Section.	With the Section re-named, this paragraph fits with the section.
39/Hay	1-3		Re-evaluate the purpose and Need of the EA. The <u>**purpose**</u> should not refer to the preferred alternative, but to the action. Recommend something like, "The purpose of the action is to establish adequate areas, testbeds, facilities for performing high explosive and high biological	Changed the beginning sentence of the paragraph in 1.3 to "The purpose of the proposed action is to establish adequate areas, testbeds and facilities for performing high explosive and biological and chemical collateral damage assessments." Removed the

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			and chemical collateral damage assessments." For the **need**, recommend using the mission of the DTRA; i.e., " The need of the action is to reduce the present and future threats from weapons of mass destruction (chemical, biological, radiological and high explosive) through combat support, technological development, threat control and threat reduction.	reference to the proposed action. The Need was felt to be sufficient as the statements suggested expressed the same idea as the second paragraph of 1.3.
40/Hay	1-3		Recommend adding a paragraph that briefly defines the criteria required for all considered alternatives. For example, "To meet the purpose and need of the EA, all alternatives under consideration would have to support the requirements for: 1) construction a variety of temporary targets (i.e., hardened reinforced bunkers, concrete pads, mission related structures, etc.), above and below ground to be rebuilt and reused repeatedly; 2) performing high explosive and conventional explosive tests, above and below ground, using a multiple variety of explosives and live and inert warheads, including penetrator warheads; 3)examining the behavior of plumes containing released chemical and/or biological agent simulants; 4) demonstrating multiple munition delivery systems (i.e., air-delivered bomb drops, gun tests, surface to surface munition systems (Army TACMS, etc.), cruise missiles, etc.; 5) disposing test-related construction materials; and 6) constructing and maintaining adequate administration facilities. Recommend this also include geographical, climatic, etc. criteria that must be met.	The requirements are listed in table format in Section 3.2 Alternatives Testing Facilities, page 14, also showing the ability of the different testing facilities to meet these requirements. This is also discussed in text format on page 13.
41/Hay	5-15		Recommend that all alternatives, including the proposed alternative, be structured to show how the criteria of the EA will be addressed.	The table in 3.2 on page 14 is structured to do this.
42/Hay	5-15		Recommend stating briefly that the Proposed Action would expand the scope of current actions performed on WSMR in order to provide more flexibility capable of supporting	The statement "If implemented, these actions will ensure a more accurate assessment of the most up-to-date weapon systems to defeat hardened targets", (on page 5, under

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			changing world conditions. This should be followed by what's proposed to meet the criteria (i.e. maintaining the current PHETS and adding other potential hard rock areas, SHIST, Alternate SHIST, etc.; adding new simulants and variety of munition delivery systems; providing more permanent facility changes, etc.) Recommend providing a map of hard rock areas and potential sites (NOTE: The potential areas must be able to support a FONSI). Recommend that the areas be identified in the alternatives section but described in the Affected Environment section, and the potential affects pointed out and mitigated in the Env. Conseq. and Mitigation Section to eliminate redundancy. NOTE: The proposed Action which would make the sites and actions permanent, will require consultation with the SHPO and possibly a new MOU.	2.0 proposed action) reflects that the expanded scope would support changing world conditions. Section 2.0 (page 5) is laid out in the way described here. 2.1 covers on-going (current) test activities and 2.2 covers advanced weapon systems and test concepts (adding new simulants and variety of munition delivery systems). There is no plan to make facilities more permanent, there is merely discussion of expansion. SHIST and Alt. SHIST are currently used for penetration testing. None of the actions are intended to make the site and actions permanent. All structures on-site will be temporary and upon closure reclamation of the area will commence.
43/Hay	5-15		Recommend that the No Action (para 3.4, pg 15) state that operations would continue as documented in the previous EAs (refer to the Reference Section), and briefly summarize how the criteria are being met. Also focus on how reclamation will be performed when the current EAs Expire and the 'Temporary' sites will be restored (discussed in Environmental Consequence and Mitigation Section).	No action alternative states that operations would continue as documented. Added a sentence to section 3.4 No-Action Alternative reading, "At PHETS, SHIST, and Alt. SHIST this would entail the returning of the sites to their original condition by re-contouring, filling in of craters and reseeding of the areas as detailed in earlier NEPA documents." This information is located in several sources including: the Environmental Assessment of Long-term High Explosive Testing at White Sands Missile Range (1987) (under 4.4 Cleanup Phase), and Dipole Sampson Environmental Assessment (1997) (under 2.3.4 Ground-Disturbing Activities).
44/Hay	5-15		The alternative of closing the currently used areas would have to be included in discussion new sites on and off WSMR. This would include reclamation and restoration of closing the existing sites (discussed in the Environmental Consequences and Mitigation	PHETS could still be utilized even if the proposed testing was done elsewhere. The documentation covers use of the sites until 2008.

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			section).	
45/Hay	5-15		Recommend that tables 3 and 4 (pages 12 and 14) be combined and modified to show how all considered alternatives (including the proposed) meet the criteria.	The tables would be confusing if merged and were not modified.
46/Hay	17-34		Recommend that comments supplied by WS-ES-ES and WS-ES-EC be applied.	The comments have been incorporated into the document or responded to in the response grid.
47/Hay	33-34/4.10		Recommend that in Socioeconomics and Infrastructure reflect the other WSMR projects that use the proposed areas of the EA. Potential effects to other range users should also be addressed in the Environmental Consequence and Mitigation Section.	Added a general comment about overall WSMR influence in 4.10.1 Economy reading "The economic region of influence for WSMR activities include surrounding communities in Doña Ana, Lincoln, Otero, Sierra, and Socorro Counties in NM, and El Paso County in Texas. WSMR injects approximately $1,000,000/day into the economy of the region including monies from salary and local contract dollars. (WSMR Public Relations website, 2001)." Added sentence about utility sources reading, "Electricity is provided to WSMR from several commercial sources." WSMR communications were already discussed in the section.
48/Hay	Env Conseq		Include, under each resource, separate subsections that present potential effects for each alternative, not just the Proposed Action. Recommend using tables comparing the considered actions to potential effects.	The potential effects for the alternatives are listed in 5.11 Environmental Consequences of Alternatives to Proposed Actions.
49/Anderson			Descriptions of flora, vegetation and possible land management problems are adequate and sufficiently general to include all variations, yet sufficiently precise to be useful in describing particular habitats.	No response necessary.
50/Anderson			The environmental consequences are well described as related to potential land management problems, vegetation structure and plant species of interest (SOI).	No response necessary.
51/Anderson			The proposal to monitor air, vegetation, soil and fauna in the future to predict possible effects by cumulative build-up of chemical substances to be used is supported. Existing LCTA plots should be	The photos of the newly established test and control plots will be supplied for the LCTA database.

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			carefully reviewed to determine whether any of them would be useful for this purpose. The document states on page 57 that there are no LCTA plots in existence at Alternate SHIST Site. However, some photo points were established and should be documented within the LCTA database. The first photos taken at the beginning of the project should be on file and would be valuable for comparison.	
52/Anderson			The Summary of Mitigation(s) is complete in relation to land management, flora and vegetation concerns. The question is will we (WS-ES) have enough incoming monitoring information to catch and identify all instances where mitigation actions should be employed?	The proponent will distribute data to WS-ES on an annual basis.
53/Mallouf	Cultural Resources		The cultural resource portions of the PEA appear to be appropriately worded and acceptable. No changes are required at this time.	No response necessary.
54/Mallouf	Cultural Resources		Recommend that the MOU between NM SHPO and WSMR, dated 5 May 88, be noted in the document	The document is noted in 5.3.1 as Eidenbach, 1988; it will be added to the reference section where it is missing.
55/Morrow	T&E Species		Recommend that the proponent refer to the Draft WSMR Integrated Natural Resources Management Plan (INRMP) to determine consistency between the proposed actions of the subject PEA and with natural resource management objectives established by the Range. The ES-ES expects the INRMP to be signed by the Commanding General and finalized in the first part of November 01. Potential inconsistencies between the proposed actions and INRMP goals and objectives should be coordinated with ES-ES prior to finalizing the EA and WSMR approval.	Because the plan has not yet been implemented and a draft copy is not available to the proponent, it is not prudent to refer to the document or to list measures that comply with the plan. All reasonable actions will be taken to comply with the plan once it is finalized for future DTRA activities. A draft of this *PEA* will be supplied to WS-ES for comment.
56/Morrow	T&E Species		The Preliminary Draft PEA does establish that the region of influence for the proposed actions do occur in identified potential habitat of the federally endangered Northern aplomado falcon. Based on past	The draft *PEA* will be supplied to USFWS for comment. Please refer to the above response in reference to the INRMP.

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			informal consultations with the US Fish and Wildlife Service (USFWS), the mere presence of activities within these habitats constitutes a "may affect" determination, IAW USFWS regulations for compliance with the Endangered Species Act. A "may affect" determination requires formal consultation with the USFWS unless WSMR and the proponent can justify a "may affect, but not likely to adversely affect the species" determination. Concurrence on this determination by the USFWS is required to negate the need for a biological assessment and formal consultation. Recommend that the PEA refer to goals and objectives identified within the INRMP for the protection of the species/habitat and the Proponent agree to comply as necessary.	
57/Morrow			Recommend that a formal Draft PEA be developed and submitted to the New Mexico Department of Game and Fish, USFWS, and the New Mexico Energy, Minerals and Natural Resources Department for review and comment.	These agencies are on the distribution list for the Draft *PEA*.
58/Morrow			The ES-ES requests the opportunity to review and comment on the Draft PEA before submitting the document to the regulators.	The Draft *PEA* will be provided to WS-ES before submission to the regulators.
59/Blough			Transcript of memo dated 11Dec01 forwarded to Karen Hay: "Bob Andreoli and I have reviewed the draft dated 6 November prepared by Newtec/Walcoff. We both had significant concerns with the original draft. They addressed the bulk of these concerns by dropping two of the most toxic and mobile simulants from the proposed action. We recommend approving this EA at this point. Use of the simulants will require significant technical evaluation such site specific data collection and numerical simulation etc. in an EIS type evaluation if they really want use these in the future."	The simulants referred to in the memo are DEMP and DIMP.

CSTE-DTC-WS-SD-S (530)
14 December 2001

MEMORANDUM FOR CSTE-DTC-WS-ES-ES

SUBJECT: OPSEC Review Programmatic Environmental Assessment for the Permanent High Explosive Test Site and Bedrock Penetration Test Sites, White Sands Missile Range, New Mexico

1. I have completed an Operations Security (OPSEC) review of the subject material, and concur in the technical decision that the subject material contains no information considered sensitive but unclassified (SBU) or FOR OFFICIAL USE ONLY.

2. I did observe one apparent discrepancy in the document. Specifically, there appears to be a conflict between Table 3 on page 14 and Table 10 on page 58. Table 3 indicates that the SHIST and Alt. SHIST sites may have 100 lb and 1000 lb static HE tests. However, Table 10 indicates such tests are "NA". In all other aspects the Tables agree.

3. Request ES personnel affix this distribution statement to any hardcopy of the material and on any CD-ROM intended for distribution: Approved for public release - Distribution is unlimited.

Attachment
CHRISTOPHER MCDONALD, CISSP
as Security Specialist
Directorate of Law Enforcement and Security

Chris Mc Donald, CISSP
CSTE-DTC-WS-SD-S
DSN 258-6944
COMMERCIAL 505-678-6944

Response to Item #2: The discrepancy has been corrected in Table 10 to reflect that up to ten tests per year are allowed in SHIST and Alt. SHIST for 100-lb. and 1,000-lb. static HE detonations.

DEPARTMENT OF THE ARMY
U.S. ARMY WHITE SANDS MISSILE RANGE
100 HEADQUARTERS AVENUE
WHITE SANDS MISSILE RANGE, NEW MEXICO 88002-5000

REPLY TO
ATTENTION OF

Environment and Safety Directorate

063900

RECEIVED
DEC 21 2001
PAY
HISTORIC PRESERVATION DIVISION

Mr. Elmo Baca
State Historic Preservation Officer
New Mexico Historic Preservation Division
228 East Palace Avenue
Santa Fe, New Mexico 87503

Dear Mr. Baca:

Enclosed for your review and comment is the *Draft Programmatic Environmental Assessment (PEA) for the Permanent High Explosive Test Site and Bedrock Penetration Test Sites, White Sands Missile Range, New Mexico.* This PEA documents the results of the analyses of the potential environmental effects as a result of weapon system testing against hardened military targets in the northern part of White Sands Missile Range. Related testing activities include static high explosive tests, projectile penetration tests in bedrock, collateral damage assessments using chemical and biological agent simulants, and counter-terrorism tests. This document is designed to aid in the decision-making processes during all phases of the proposed action to minimize adverse environmental effects.

Your expertise is highly valued, and we would appreciate your comments. Please submit all correspondence to:

Department of Army
U.S. Army White Sands Missile Range
100 Headquarters Avenue
ATTN: CSTE-DTC-WS-ES
White Sands Missile Range, New Mexico 88002-5000

Questions may be directed to Ms. Karen Hay, White Sands Missile Range, Environment and Safety Directorate, Customer Support Division, at (505) 678-2224/7863/8266.

COMMENT
P.G. Young 12/24/01
NMSHPO

Thank you for the opportunity to review this P.E.A. We look forward to future consultation under Section 106 of the NHPA.

Sincerely,

Thomas A. Ladd

Thomas A. Ladd
Director, Environment and
Safety Directorate

Enclosure

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New Mexico Ecological Services Field Office
2105 Osuna NE
Albuquerque, New Mexico 87113
Phone: (505) 346-2525 Fax: (505) 346-2542

January 31, 2002

Cons.# 2-22-02-I-170

Department of the Army
U.S. Army-White Sands Missile Range
100 Headquarters Avenue
Attn: CSTE-DTC-WS-ES
White Sands Missile Range, New Mexico 88002-5000

Re: Review of Draft Programmatic Environmental Assessment for the Permanent High Explosive Test Site and Bedrock Penetration Test Sites at White Sands Missile Range, New Mexico

Dear Mr. Ladd:

This responds to a letter we received on December 26, 2001, requesting comments on the draft Programmatic Environmental Assessment (PEA) for the potential environmental effects of the Permanent High Explosive Test Site and Bedrock Penetration Test Site activities. The preferred alternative involves static high explosive tests, warhead penetration tests, collateral damage assessments using approved chemical and biological weapon simulants, and counter terrorism tests. Collateral damage assessments involve the release of simulant plumes to assess effects to the human and natural environments near the defeated military targets. The counter terrorism tests involve small-scale explosions contained in or near an existing four story structure. All four types of tests will occur at existing testing sites, designated for these purposes, located in the northern portion of White Sands Missile Range (WSMR). These sites are the Permanent High Explosive Test Site (PHETS), the Seismic Hardrock In Situ Test (SHIST), and alternative SHIST sites. Other proposed actions include expansion of the construction landfill at PHETS by 9 hectares and the SHIST site by 14 hectares, respectively. Currently, the PHETS site is 9,068 hectares, the SHIST site is 23 hectares, and the alternative SHIST is 7 hectares in size.

GENERAL COMMENTS

The U.S. Fish and Wildlife Service (Service) has evaluated the draft PEA with respect to species federally-listed or proposed for listing as threatened or endangered, as well as other important fish and wildlife resources. In general, the draft PEA is adequate in addressing fish and wildlife resource concerns. However, the document does not include some precautions that would ensure that the proposed project would not adversely impact resident wildlife, including federally-listed species. For your consideration, we offer the following comments, additions, and/or clarifications.

SPECIFIC COMMENTS

Page iii, Executive Summary

This section states the black-tailed prairie dog is a federally-protected species. Please note that the black-tailed prairie dog is currently a candidate species. Candidate species are taxa for which the Service has sufficient information to propose that they be added to the list of endangered and threatened species, but the listing action has been precluded by other higher priority listing activities. Although there is no consultation requirement for candidates under the Endangered Species Act, actions that may contribute to the need for listing should be avoided.

Page 16, Section 3.3, Alternate Test Sites, third paragraph

This section shows the White Sands pupfish as a "federal species of concern." To avoid confusion here and in other parts of the PEA, we recommend omitting "federal" with reference to species of concern. Species of concern are not official federal designations. They are taxa for which further biological research and field study are needed to resolve their conservation status OR are considered sensitive, rare, or declining on lists maintained by Natural Heritage Programs, state wildlife agencies, other federal agencies, or professional/academic scientific societies. Species of concern are included on Service lists for planning purposes only.

Page 46, Section 5.2.2, High Explosive Tests

As in other sections which describe construction activities or mowing, this section states that 200-300 meters of terrain around a planned explosion test will be graded flat. Recently, many migratory bird species protected under the Migratory Bird Treaty Act (MBTA) have undergone significant declines. We routinely recommend that applicants/action agencies avoid impacting birds protected under the MBTA, such as conducting vegetation disturbance activities outside of any nesting areas or outside of the general migratory bird nesting season that extends from March through August. In addition, Section 9.2 (Summary of Mitigation) states if certain species are found or seen in the testing areas, consultation with the WSMR Environmental Directorate (WS-ES) will occur or the species (such as desert bighorn sheep) will "be encouraged to leave the area". However, it is unclear if qualified personnel will be assigned to these tasks should any sensitive species occur within the action area. The Service recommends a qualified biological monitor be assigned to conduct a prior check for sensitive resources (such as nesting birds) of the specific action area(s).

Thomas A. Ladd 3

Page 48, Section 5.2.3, Threatened, Endangered, or Sensitive Species, Fauna

This section states that "failure to detect individuals during formal surveys indicates that WSMR does not currently support a resident population". If project activities are occurring within recently un-surveyed suitable habitat or WSMR-established survey areas were surveyed outside the most recent nesting season (i.e., the WSMR survey program along established survey transects has been discontinued or interrupted); then we recommend adequate surveys by a qualified biologist or Environmental Directorate biologist to ensure aplomado falcons have not subsequently moved into the suitable habitat action area(s). Aplomado falcons are highly mobile species but may frequent an area (and are best detected) during the breeding season, mostly between March through June. If aplomado falcons are identified, we recommend contacting this office for further consultation prior to conducting the activity.

Page 65, Section 8.0, Irreversible and Irretrievable Commitment of Resources, 2nd paragraph
This section states "there will be no loss or impact on threatened or endangered species..." This statement is unsupported in the current PEA version or it is unclear how this will be attained. We recommend inclusion of the previous comment within Section 9 of the PEA. Upon inclusion, Section 8, 2nd paragraph, 1st sentence should be revised to read: Based on the resource-protective measures for listed species within the PEA and/or WSMR survey protocols, these species are not likely to be adversely affected and no loss of cultural resources....is anticipated.

Page 70, Section 9.2, Biological Resources
This section states personnel will be instructed not to harm, harass, or collect fauna. This should also include flora, especially cacti and yucca. In addition, this seems contradictory with the statement on page 68 that "large mammals ....will be driven away by project personnel." A qualified biological monitor or coordination with the State may be more appropriate in addressing the presence of sensitive species such as desert bighorn sheep.

Page C4, Appendix C, Hazards of Biological Simulants, Bacillus thuringensis var. karstaki
Because this may adversely affect insect populations, particularly pollinator species of moths and butterflies, we recommend avoiding its use entirely or from March 1 through September 30.

SUMMARY COMMENTS

To more fully support the PEA's conclusion in Section 10 (finding of no significant impact) and to address potential listed species concerns, we recommend amending the draft PEA to include the above comments. We appreciate your consideration for New Mexico's unique wildlife resources during the planning and implementation stages of your project.

Thomas A. Ladd 4

If we can be of any further assistance, please contact Chris Perez of my staff at (505) 346-2525, ext. 145.

Sincerely,

Joy E. Nicholopoulos

Joy E. Nicholopoulos
Field Supervisor

cc:
Director, New Mexico Department of Game and Fish, Santa Fe, New Mexico
Director, New Mexico Energy, Minerals, and Natural Resources Department, Forestry and Resources Conservation Division, Santa Fe, New Mexico
WS-ES, Environmental Directorate, White Sands Missile Range, New Mexico (Dave Holdermann)
Fish and Wildlife Service, Regional Permits Office, Albuquerque, New Mexico (Stephanie Weagley)
Refuge Manager, San Andres National Wildlife Refuge, Las Cruces, New Mexico

Response to United States Fish and Wildlife Service Comments Dated 1/31/02

Comment 1: The wording on page iii, Executive Summary and throughout the document has been changed to reflect that the black-tailed prairie dog is a candidate species.

Comment 2: In section 3.3 and throughout the document, the word "Federal" was removed from "Federal species of concern."

Comment 3: White Sands-Environment and Safety Directorate (WS-ES) requires a Record of Environmental Consideration (REC) be prepared for all activities discussed within this document. As part of a REC, a biological assessment of the area is required and a qualified biologist will conduct a survey for sensitive resources in the area, including birds. It is acknowledged that there is no need to encourage species to leave a testing area, given that a qualified biologist will have previously done an inspection. Mention of "… encouraging species to leave the area…" has therefore been removed from the document.

Comment 4: David Holdermann (wildlife biologist, WS-ES) confirmed that surveys for aplomado falcons are performed annually and that the last surveys took place in 2001. This comment was added to 5.2.3 Threatened, Endangered and Sensitive Species, page, 48.

Comment 5: This sentence was removed and replaced with the suggestion in the letter, "Based on the resource-protective measures for listed species within the PEA and/or White Sands Missile Range survey protocols, these species are not likely to be adversely affected and no loss of cultural resources is anticipated."

Comment 6: Flora was added to the statement "personnel will be instructed not to harm, harass, or collect fauna." The statement "large mammals…will be driven away by project personnel" was removed.

Comment 7: Bt is applied as a biological insecticide for agricultural purposes at a rate of approximately 0.13 lbs Bt/acre, based upon the application rate for DiPel®2X, a commercial brand. Simulant plume data from DIPOLE JEWEL tests in 1998 (using sulfur hexaflouride as tracer material) indicated that concentrations would potentially only reach levels used in agricultural applications immediate to the test structure. At greater distances, Bt concentrations will fall off rapidly. Mortality in moths and butterflies close to Bt releases will almost certainly occur; however, test beds where bio-simulants will be used are currently situated in highly disturbed areas with sparse vegetation and are not expected to contain large concentrations of these insects.

Degradation of this simulant is rapid in sunlight and will therefore not persist on the land surface. The recommendation to suspend Bt tests from March through September will be considered, but may be superseded by other testing imperatives to meet project goals.

GOVERNOR
Gary E. Johnson

STATE OF NEW MEXICO

DEPARTMENT OF GAME & FISH

One Wildlife Way
P.O. Box 25112
Santa Fe, NM 87504

DIRECTOR AND SECRETARY
TO THE COMMISSION
Larry G. Bell

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For basic information or to order free publications: 1-800-862-9310

January 31, 2002

Mr. Thomas A. Ladd
Director, Environment and Safety Directorate
Department of Army
U.S. Army White Sands Missile Range
100 Headquarters Avenue
Attn: CSTE-DTC-WS-ES
White Sands Missile Range, NM 88002-5000

Re: Permanent High Explosive and Bedrock Penetration Test Sites Programmatic Environmental Assessment, White Sands Missile Range
NMGF Doc. No. 7802

Dear Mr. Ladd:

The Department of Game and Fish (Department) has reviewed the Programmatic Environmental Assessment for the Permanent High Explosive and Bedrock Penetration Test Sites (PEA). During our 29 March 2001 scoping meeting at the Defense Threat Reduction Agency (DTRA) office at Kirtland Air Force Base, we voiced our concerns regarding the potential for these projects to impact state-listed desert bighorn sheep (*Ovis canadensis mexicana*) and White Sands pupfish (*Cyprinodon tularosa*). We are concerned primarily with the potential for impacts from 1) mining operations and bombing on desert bighorn sheep in the San Andres Mountains from the Bedrock Penetration tests; and 2) biological and chemical warfare agent simulant tests on White Sands pupfish.

DTRA proposes to test 30+ biological and chemical warfare agent simulants within 15 miles of known occupied pupfish habitat. Plumes from previous tests have been known to travel up to 30 miles. Therefore, we requested in our 11 April 2001 comments on the draft PEA that the PEA contain 1) a thorough analysis of the potential effects of these agents to aquatic biota in general and White Sands pupfish in particular; 2) Material Safety Data Sheets (MSDSs) for each agent; 3) a record of plume tests at PHETS; and 4) an opportunity to visit the test sites.

Although we have not been afforded the opportunity to visit the test sites, the Department does appreciate the inclusion of the information we requested in the PEA. This information allows the reader a greater opportunity to evaluate the potential effects of these simulants and explosives on the surrounding biota. After review of the PEA, we agree that it is unlikely that plume simulants will be deposited in pupfish habitat, but also note that several of the simulants (TEP, Bt, and Bg) have been experimentally determined to be lethal to fish at dosages from 100 mg/l to 400 mg/l. We request that the surface water quality

Mr. Thomas A. Ladd 2 January 31, 2002

monitoring plan for White Sands pupfish habitats agreed to by WSMR in the recently signed Integrated Natural Resource Management Plan will monitor for simulants and residual explosives chemicals, if possible.

Although the minutes from the scoping meeting printed in the PEA states that NMGF wants to be notified in case of an accident to pupfish habitat from these projects, we would like to clarify that within the White Sands Pupfish Cooperative Agreement, WSMR has committed to notifying signatory agencies in the event of an accident.

We appreciate the opportunity to comment on these projects. Should you have any questions regarding our comments, please contact Mark Watson, Habitat Specialist of my staff at 476-8115, or mwatson@state.nm.us.

Sincerely,

Tod W. Stevenson

Tod W. Stevenson
Chief, Conservation Services Division

TWS/MLW

Cc: Scott Brown (Assistant Director, NMGF)
Bill Hays (Conservation Services Assistant Chief, NMGF)
David Propst (Endangered Fishes Biologist, NMGF)
Nic Medley (Conservation Services Aquatic Habitat Specialist, NMGF)
Pat Mathis (Southwest Area Habitat Specialist, NMGF)
Alise Goldstein (Bighorn Sheep Biologist, NMGF)
Mark Watson (Conservation Services Habitat Specialist, NMGF)

Response to New Mexico Department of Game and Fish Letter Dated 31January02

As stated in the Integrated Natural Resource Management Plan (INRMP, page 316), finalized in 2001, a project is planned to monitor the impact from both the Liquid Propellant Target Program (LPT) and the Permanent High Explosive Test Site (PHETS) plume studies. The INRMP states "the study will conduct hydrologic evaluations of pupfish habitat, install and monitor stream and pond gauges, conduct water quality analyses, and monitor wells." WS-ES-ES has indicated that this project is planned and will be implemented.

-----Original Message-----
From: Curt Frischkorn [mailto:Curt_Frischkorn@nmenv.state.nm.us]
Sent: Monday, February 11, 2002 2:54 PM
To: hayk@wsmr.army.mil
Subject: Draft EA for the PHETS and SHIST sites

Karen:

The NMED, Ground Water Quality Bureau(GWQB) requests that a Notice of Intent(NOI) be submitted for the Permanent High Explosives Test Site. NOIs are required to be submitted for any "water contaminant" discharge. The requirements for submittal of an NOI are listed in the Water Quality Control Commission Regulations under NMAC 20.6.2.1201. The GWQB is specifically concerned about the impacts to ground water quality resulting from discharges to the expanded septic system, and from the release of simulants, taggants, and other associated chemicals to the environment. Please submit the NOI and associated information within 30 days. Thank you.

Curt Frischkorn, Geologist
New Mexico Environment Department
Ground Water Quality Bureau
Harold Runnels Building
1190 St. Francis Drive
Santa Fe, New Mexico 87502
(505) 827-0078

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Responses to New Mexico Environment Department, Ground Water Quality Bureau electronic mail dated 11 February 2002:

A Five-Year Plan for the PHETS administrative area has been outlined in the programmatic environmental assessment (PEA) and will include expansion of the septic system. At this time of writing, there is no schedule set for this activity. At the request of the GWQB, a notice of intent (NOI) is being prepared to generally document the septic system expansion.

The PEA has addressed the lack of viable pathways for simulants and other test materials to reach ground water. However, the NOI will also include the list of simulants and other materials approved for testing for information purposes.

The monitoring wells completed for this PEA are for obtaining samples only and will not receive injections of any kind; therefore, a NOI to discharge water contaminants would not apply.

Comment from John (kwjuan@juno.com) dated 25February02

-----Original Message-----
From: kwjuan@juno.com [mailto:kwjuan@juno.com]
Sent: Monday, February 25, 2002 8:20 AM
To: hayk@wsmr.army.mil
Subject: Programmatic Environmental Assessment

Karen Hay,

I obtained your name as the appropriate individual to send my comments on the Programmatic Environmental Assessment for the High Explosive Test Site and Bedrock Penetration Test Series White Sands Missile Range, New Mexico.

In reviewing the document, I noticed incendiary devices and other explosives may be used in the future in different weapon types. Will this testing include the new thermobaric weapons that have recently been in the news?

John

Response from Major Jeffrey Fraher, Defense Threat Reduction Agency

Thermobaric weapons testing will be performed at various PHETS sites. The weapons that are currently planned for testing are existing weapon systems with a thermobaric explosive fill replacing the standard fill within each weapon.

There is still no definitive explosive mixture used as a thermobaric explosive. Depending on the desired outcome, different explosives and mixtures have shown better results. Future testing will try to narrow down the possible mixture in attempt to create a single fill that solves most of the targeting requirements.

Thermobaric explosives are basically a mixture of existing explosive materials with a metallic powder (typically aluminum) and possibly an oxidizer.

CSTE-DTC-WS-ST-AA

MEMORANDUM FOR ES-C, ATTN: Ms. Hay

SUBJECT: Project RC02051a

1. In response to your verbal request, the Applied Environments Test Branch Chemistry Laboratory examined the following documents: (1) Draft Programmatic Environmental Assessment (PEA) for the Permanent High Explosive Test Site (PHETS); (2) Material Safety Data Sheets (MSDS's) for Chemical and Biological Simulants, High Explosives and Related Test Materials proposed for use in the PHETS PEA; (3) Additional MSDS's that describe several modified explosive formulations proposed for use at the PHETS in upcoming project RC02051a.

2. The proposed test will include the use of two Thermobaric warheads. These are warheads containing conventional high explosive compounds that have been modified primarily by the addition of powdered aluminum and, secondarily, in some applications, by the addition of ammonium perchlorate oxidizer.

3. The PHETS PEA was created to provide the flexibility required to be able to test a variety of high explosive formulations in the future, the compositions of which were not known when the PEA was drafted. A study of the proposed explosive formulations described in the MSDS's in (3) above reveals that only small modifications have been made to the explosives documented in the PHETS PEA.

4. The Thermobaric warhead explosive composition will result in some aluminum oxide being formed during the explosive event. Should the Thermobaric warhead explosive mixture also include ammonium perchlorate, some hydrogen chloride would also result.

5. Based upon the information contained in the provided documentation, the proposed Thermobaric warhead experiment at the PHETS appears to fall within the purview of the PHETS PEA.

6. Point of contact is Dr. Joseph E. Gomez at 678-2992.

ANDRUS GARAY
Chief, Applied Envr Test Branch