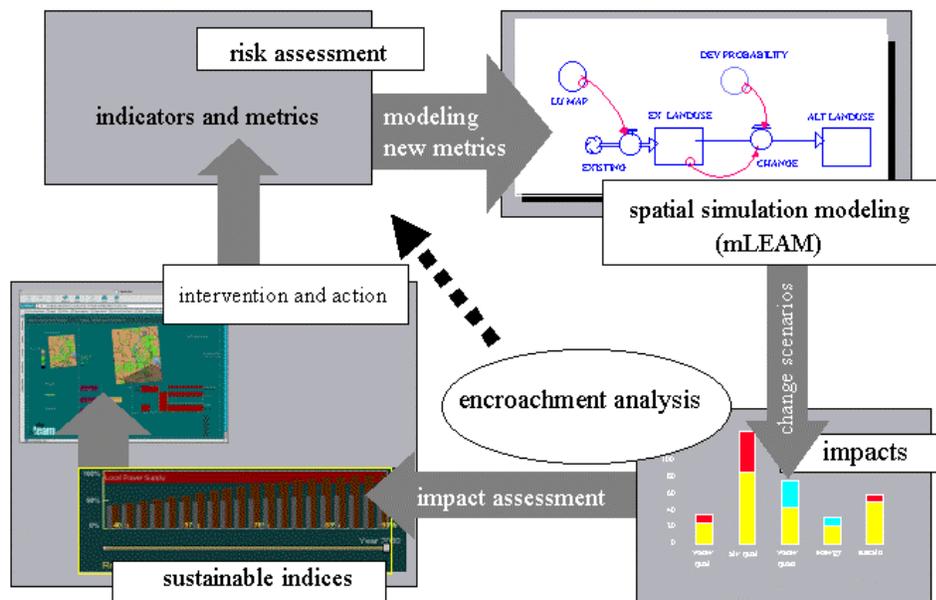




# An Assessment of Encroachment Mitigation Techniques for Army Lands

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## Foreword

This study was conducted for the Directorate of Civil Works, Headquarters, U.S. Army Corps of Engineers (HQUSACE) under Project 622784AT41, "Military Facilities Engineering Work Unit KHD730, "Energy and Transportation Indices Plus Cost." The technical monitor was Joe McCarty, CECW-ET.

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# Contents

<b>Foreword</b> .....	<b>2</b>
<b>List of Figures and Tables</b> .....	<b>5</b>
<b>1 Introduction</b> .....	<b>7</b>
1.1 Background .....	7
1.2 Objectives .....	10
1.3 Approach .....	11
<b>2 Current Legislation, Army Policy, and Available Methods</b> .....	<b>12</b>
2.1 Enabling Legislation and Restrictions .....	12
2.2 U.S. Army Regulations and Policy .....	15
2.3 Private Property Issues and Easement Opportunities .....	19
2.4 Current Approaches to Encroachment Mitigation .....	20
2.5 Proposed Enabling Legislation .....	23
<b>3 Encroachment Mitigation Case Studies</b> .....	<b>25</b>
3.1 Fort Bragg, North Carolina.....	25
3.2 Fort Hood, CO.....	28
3.3 Fort Huachuca, Arizona .....	30
3.4 Lessons Learned from Case Studies .....	33
<b>4 Recommended Approach to Encroachment Mitigation</b> .....	<b>35</b>
4.1 Determine Needs through Risk Assessment .....	36
4.2 Understand Options for Encroachment Mitigation .....	43
4.3 Establish a Collaborative GIS for Mitigation Planning .....	46
4.4 Model Regional Landuse Change and Urban Dynamics.....	47
4.5 Support Regional Cooperative Efforts .....	50
4.6 Assess Private Lands for Acquisition .....	53
<b>5 Summary and Recommendations</b> .....	<b>64</b>
5.1 Summary.....	64
5.2 Recommendations .....	65
<b>Bibliography</b> .....	<b>68</b>
<b>Appendix A: Selected Risk Indicators for Encroachment Related Land Use Issues</b> .....	<b>70</b>

**Appendix B: Army Installations by Risk Category .....72**

**Appendix C: Agencies and Organizations Interested in Land Use Issues and  
Potential Cooperative Agreement Partners.....78**

**CERL Distribution .....85**

**Report Documentation Page .....86**

# List of Figures and Tables

## Figures

1	Encroachment management cycle.....	36
2	The mLEAM spatial modeling environment .....	48
3	mLEAM model drivers.....	50

## Tables

1	Risk assessment framework .....	39
2	Stressors and indicators for exogenous risk potential .....	42
3	Stressors and indicators for endogenous risk potential .....	42
4	Encroachment risk assessment .....	44
5	Examples of goal-specific landscape characterization .....	56
6	GIS-ready data sets .....	59

# 1 Introduction

## 1.1 Background

Societal changes, demographics, and environmental issues affect the Army's ability to use its training lands and installations effectively. The Army's areas for training represent about one-half of one percent of the nation's total land area. Since those areas have been isolated from development, they have become havens for unique natural and cultural resources. Army training activities, carried out long before environmental statutes were enacted, have indirectly served to protect the environment. Ironically, it was the Army's range management practices that aided in the creation of these havens and allowed them to flourish. This has occurred not in spite of training, but because of training (Van Antwerp, 2001).

For most of its history, the United States has had no effective environmental legislation. Federal regulation to protect human health or the environment was unknown until the mid-20<sup>th</sup> century. Up until the late 1960s, state and local governments had the responsibility for environmental problems. Over the last 30 years, the Nation has begun to understand and regulate the potential environmental impacts of a wide variety of civil and industrial practices. During the 1970s and 1980s, Federal legislation established rules for national environmental protection, including the Endangered Species Act (ESA), the Clean Air Act (CAA), Clean Water Act (CWA), the Resource Conservation and Recovery Act of 1976 (RCRA), and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). These legislative initiatives have resulted in substantive requirements that affect military land use and training. The National Environmental Policy Act (NEPA) requires that training decisions take environmental impacts into account and, in 1992, Congress amended RCRA to clarify that Federal agencies may be penalized for failure to comply with its provisions.

Army lands and ranges have been used for testing and training with a wide variety of weapons systems for well over a century. When Army installations were established, they were generally in remote areas, isolated from populations. There was little residential or commercial development nearby and the public had little awareness of training activities. That has changed, over the last sev-

eral decades, the population and the amount of developed land around most U.S. cities have grown significantly.

Now these lands are susceptible to enforcement actions based on increasing application of environmental statutes. A number of these statutes contain broad discretionary enforcement thresholds that are based on the assessment of the environmental regulatory authority as to whether a given condition presents a “potential” risk or “imminent” hazard to human health or natural resources.

Meanwhile, the Army’s ranges and training lands have remained undeveloped and insulated from the urbanization and sprawl development that has covered much of the landscape. Development lead to habitat destruction leaving undeveloped ranges and training lands to become “islands of biodiversity.” Their value as habitat and a natural resource base has steadily increased over time. Population centers expanded—up to or near installation boundaries—and residential development has occurred in more remote areas and previously rural settings. Therefore, citizens became more aware of training and range activities. Economic expansion, some of it probably driven the installation’s economic impact in the local area, has resulted in new suburban communities developing near Army installations. The resulting effect is that Army installations are now often in the midst of large urbanized areas. Military training activities produces noise, dust, the expenditure of munitions, and ground activities that can be viewed as a nuisance and annoyance to those who now live nearby. Also, training activities may prevent access to the most pristine land in the region.

This combination of factors—new laws and nearby urban development—is now creating significant pressure to alter land use practices on military installations. These pressures are termed “encroachment,” which is a general descriptor for the many pressures that limit the military use of land, air-, and sea-space (Angello, 2001). The Department of Defense (DoD) has identified eight categories of encroachment. While there are other valid encroachment concerns, the issue areas most likely to negatively affect readiness in the immediate future are:

- endangered species and critical habitat
- unexploded ordnance and munitions
- frequency encroachment
- maritime sustainability
- airspace restrictions
- air quality
- airborne noise
- urban growth.

For each encroachment area, the DoD has identified lead points of contact to frame issues, assess impacts, and propose possible resolutions. During the past year, eight action plans were drafted, coordinated, and staffed within DoD as a unified set. These remain in draft form and are currently undergoing review; the plans provide a preliminary roadmap for DoD efforts in addressing the issue areas. For each area, an existing organization or group within DoD has been given the charter to implement the roadmap and ensure encroachment and range sustainment becomes an integral part of their area of responsibility.

Based on the Sustainable Ranges Initiative, the DoD Policy Board on Federal Aviation recently initiated a joint DoD-FAA working group to proactively identify and resolve issues surrounding the National Air Space System. The Navy, recently designated the Executive Agent for Maritime Sustainability, is actively working with the other services and Federal regulators to resolve constraints on testing and training at sea. The Range Spectrum Requirements Working Group (RSRWG), long the forum for DoD frequency spectrum problem solving and with an active role in addressing spectrum encroachment issues, has expanded its role to both test and training ranges. Coordinated action within DoD is being taken on each of the other action plan issues.

The Army's primary encroachment concerns are urban sprawl, threatened and endangered species, and restrictions that impact use of munitions or other combat related techniques such as obscurants. Army training is also affected by restrictions due to air quality standards, erosion control requirements, water quality standards, and restrictions on wetland impacts. The Army has implemented programs to ensure compliance with environmental statutes and regulations and address these issues. Most major training installations have ranges designed and constructed specifically to meet the requirements of the forces assigned to that installation. Compliance actions have led to training capability curtailments at some installations. Management of endangered species causes restrictions on timing and location of training events. Consequently, large portions of some Army ranges are unavailable during much of the year for such training activities as digging fighting positions, dismounted maneuver, occupying positions for combat, combat service support functions, and use of camouflage. As the number of listed plants and animals increases, the amount of land available for unmodified training activities may decrease further (Ellis, 2001).

These restrictions reduce the Army's flexibility to use its present land while the requirement for more maneuver space to exercise emerging weapons systems is growing. The Army is limited in its ability to acquire new land. The costs and the general public's concerns about urbanization's effects on remaining natural and agricultural lands make acquisition problematic. Residential and commer-

cial development on Army installation boundaries restricts land available for acquisition, causes competition for resources, and adds to the difficulty in executing cooperative land use agreements that can provide undeveloped buffers around ranges and training areas.

The Army must now reconcile its training and testing mission with its requirement to address multi-faceted encroachment issues while complying with environmental regulations and fulfilling its desire to act as good stewards of the natural resources. It would be unrealistic to assume that the DOD might be “exempted” from the requirements of environmental regulation. While it is true that most environmental laws provide for Presidential exemptions and that 10 U.S.C. §2014 provides for expedited Executive Branch review for administrative actions that may impact readiness, there are no exemptions from any requirements based on U.S. Code or Judicial actions. In actuality, Presidential exemptions are rarely invoked. The development of risk assessment and intervention methods is therefore required to expand the Army’s response capability to encroachment issues and other environmentally based requirements.

## 1.2 Objectives

The objectives of this work were to:

1. Review policies and the legal framework for addressing encroachment on Army installations and recommends approaches and methodologies to address this critical issue.
2. Provide “lessons learned” (based on the experiences with the Private Lands Initiative at Fort Bragg and similar activities at other installations)
3. Recommend strategies for assessing land for acquisition based on its characteristics and subsequent value to the Army, and to identify potential barriers to these strategies.
4. Provide guidelines to the crucial process of initiating effective corrective action through a plan based on an assessment of the local situation that establishes where to place emphasis and how to best proceed. Once a direction is determined, mitigating actions must be pursued within the regulatory and policy framework. (Current policy and legislative requirements define the range of available options for addressing encroachment. To date, encroachment responses have been ad hoc efforts by certain installations with help from higher headquarters and the Army Environmental Center.)
5. Recommendations on appropriate leadership actions and policy responses to address encroachment pressures.

### 1.3 Approach

This research initiative began with a review of the current legislation, policies, and methods available to address the issues of encroachment. Based on the current policy framework, legislative recommendations were reviewed and a methodology developed to address encroachment issues. This methodology was based on discussions with the Army Environmental Center and incorporates lessons learned from installation-based initiatives and related research activities underway at CERL. The issue of “encroachment” is multi-faceted and complex, and requires a careful and thoughtful response. This work proposes a methodology and policy framework intended to respond to the issue of encroachment in an integrated manner—to support the overall concept of installation sustainability.

## 2 Current Legislation, Army Policy, and Available Methods

The Army must address the issues of encroachment within the umbrella of current regulations, laws, and policy. This chapter presents a short discussion of the legal framework and salient policy requirements that will help to define the parameters for solutions.

### 2.1 Enabling Legislation and Restrictions

#### 2.1.1 10 U.S.C. §2014

Sec. 2014, “Administrative Actions Adversely Affecting Military Training or Other Readiness Activities,” Title 10, U.S. Code, states that whenever an official of an Executive agency takes or proposes to take an administrative action that, as determined by the Secretary of Defense in consultation with the Chairman of the Joint Chiefs of Staff, affects training or any other readiness activity in a manner that has or would have a significant adverse effect on the military readiness of any of the armed forces or a critical component thereof, the Secretary shall submit a written notification of the action and each significant adverse effect to the head of the Executive agency taking or proposing to take the administrative action.

At the same time, the Secretary shall transmit a copy of the notification to the President, the Committee on Armed Services of the Senate, and the Committee on Armed Services of the House of Representatives. This will invoke actions consistent with the urgency of the training or readiness activity involved and the provisions of law under which the administrative action or proposed administrative action is being taken, seek to reach an agreement with the Secretary on immediate actions to attain the objective of the administrative action or proposed administrative action in a manner that eliminates or mitigates the adverse effects of the administrative action or proposed administrative action on the training or readiness activity. Additionally, relief shall not apply with respect to an administrative action or proposed administrative action if the head of the Executive agency concerned determines that the delay in enforcement of the adminis-

trative action or proposed administrative action will pose an actual threat of an imminent and substantial endangerment to public health or the environment.

Significant to note is the legislation only provides relief from administrative actions of the Executive Branch and not from any actions of the other branches of government.

### **2.1.2 10 U.S.C. §2676**

Sec. 2676 of Chapter 159, Real Property, “Related Personal Property, and Lease of Non-Excess Property,” Title 10, U.S. Code, states that no military department may acquire real property not owned by the United States unless the acquisition is expressly authorized by law. This limitation does not apply to the acceptance by a military department of real property acquired under the authority of the Administrator of General Services to acquire property by the exchange of Government property pursuant to the Federal Property and Administrative Services Act of 1949, as amended (40 U.S.C. 471 et seq.), but certainly applies to land acquisition of new, non-Federal land.

### **2.1.3 10 U.S.C. §2694**

Sec. 2694, “Conservation and Cultural Activities,” Title 10, U.S. Code, provides for the establishment of a program to conduct and manage, in a coordinated manner, the conservation and cultural activities that have regional or Department of Defense-wide significance, involve more than one military department, and are necessary to meet legal requirements or to support military operations. Such activities include the development of ecosystem-wide land management plans, the conduct of wildlife studies to ensure the safety of military operations, or the control of invasive species that may hinder military activities or degrade military training ranges. Additionally, the Secretary of Defense may negotiate and enter into cooperative agreements with public and private agencies, organizations, institutions, individuals, or other entities to carry such a program.

### **2.1.4 16 U.S.C. §670a**

Title 16, U.S. Code, Chapter 5C, Sec. 670a, “Program for Conservation and Rehabilitation of Natural Resources on Military Installations,” requires the Secretary of Defense shall carry out a program to provide for the conservation and rehabilitation of natural resources on military installations. To facilitate the program, the Secretary of each military department shall prepare and implement an Integrated Natural Resources Management Plan (INRMP) for each military installation in the United States under the jurisdiction of the Secretary,

unless the Secretary determines that the absence of significant natural resources on a particular installation makes preparation of such a plan inappropriate.

Section 670(a) also states that each INRMP shall, to the extent appropriate and applicable, provide for “no net loss in the capability of military installation lands to support the military mission of the installation.” This is interpreted to mean that “threats” to mission land use shall be identified and addressed in INRMPs. Appropriate management objectives to protect mission capabilities of installation lands (from which annual projects are developed) should be clearly articulated in the planning process and should be high in INRMP resourcing priorities. The effectiveness of the INRMP in preventing “net loss” shall be evaluated annually. There may be, however, instances in which a “net loss” may be unavoidable to fulfill other regulatory requirements, such as complying with a biological opinion under the provisions of the Endangered Species Act or the protection of wetlands under the provisions of the Clean Water Act.

The Secretary of each Military Department must prepare and begin implementing INRMPs for those installations where an INRMP is appropriate by 18 November 2001. Also, in the case of any installation for which there was in effect a cooperative plan under section 101(a) of the Sikes Act as of 17 November 1997, the Secretary of each Military Department may “complete negotiations with the Secretary of the Interior and the heads of the appropriate State agencies regarding changes to the plan that are necessary for the plan to constitute an INRMP.”

Section 670(a) of the Sikes Act requires that each plan be reviewed “on a regular basis, but not less often than every 5 years.”

#### **2.1.5 16 U.S.C. §670c**

Title 16, U.S. Code, Sec. 670c-1, “Cooperative Agreements for Land Management on Department of Defense Installations,” provides authority for the Secretary of a military department to enter into cooperative agreements with States, local governments, nongovernmental organizations, and individuals to provide for the maintenance and improvement of natural resources on, or to benefit natural and historic research on, Department of Defense installations.

#### **2.1.6 31 U.S.C. §6305**

Title 31, U.S. Code, Sec. 6305, “Using Cooperative Agreements,” states that an executive agency shall use a cooperative agreement as the legal instrument reflecting a relationship between the United States Government and a State, a local government, or other recipient when the principal purpose of the relationship

is to transfer a thing of value to the State, local government, or other recipient to carry out a public purpose of support or stimulation authorized by a law of the United States instead of acquiring (by purchase, lease, or barter) property or services for the direct benefit or use of the United States Government; and substantial involvement is expected between the executive agency and the State, local government, or other recipient when carrying out the activity contemplated in the agreement.

### **2.1.7 41 U.S.C. §14**

Title 41, U.S. Code Sec. 14, “Restriction on Purchases of Land,” states that no land shall be purchased on account of the United States, except under a law authorizing such purchase.

### **2.1.8 Legislative Summary**

Only Congress can authorize the purchase of land and that is strongly resisted. Therefore, the blanket purchase of land to relieve encroachment pressures is not a viable alternative. Although not explicit, these sections of the U.S. Code have been interpreted as allowing the Army to enter into cooperative agreements with conservation entities to encumber land outside the installation through either fee simple purchase or with conservation easements, so long as the conservation entity holds title to the land. This enhances the conservation activities and natural resource management of an installation, thus allowing greater use of installation land assets, while meeting conservation requirement such as preserving threatened and endangered species’ habitat. Installations are required to develop INRMPs. The impacts of encroachment and how to mitigate them should also be part of these plans, as should any planned cooperative agreements to expand biodiversity and habitats furthering the mission.

## **2.2 U.S. Army Regulations and Policy**

Army regulations reflect the policy of the Army while interpreting and implementing legislative and regulatory requirements. They define the Army’s approach to complying with requirements and provide the management structure to insure compliance. A short summary of each germane is provided below.

### **2.2.1 AR 200-1**

The Army has a comprehensive environmental strategy that focuses on pollution prevention, conservation, and preservation of natural and cultural resources,

compliance with all applicable environmental laws, and restoration of previously contaminated sites that threaten either human health or the environment. The Army's environmental program is defined in Army Regulation (AR) 200-1, *Environmental Protection and Enhancement* (ACSIM 1997). The program is comprehensive and is comprised of selected subprograms that integrate together to form the complete environmental posture of an installation. Subprograms are:

- Water Resources Management Program
- Hazardous Materials Management
- Hazardous and Solid Waste Management
- Air Program
- Environmental Noise Management Program
- Asbestos Management
- Radon Reduction Program
- Pollution Prevention
- Environmental Restoration Programs
- Environmental Quality Technology Program
- Automated Environmental Management Systems
- Other systems defined in other regulations such as NEPA requirements, Natural Resources Management, and Cultural Resources Management.

The Army's program is comprehensive in nature and, when combined with other requirements delineated below and fully resourced, provides an effective and thorough approach to environmental management and natural resource conservation.

### **2.2.2 AR 200-3**

Policy, procedure, and responsibilities for the conservation, management, and restoration of land and the natural resources thereon are found in AR 200-3 *Natural Resources—Land, Forest, and Wildlife Management* (ACSIM 1995). The U.S. Army adheres to the declared National policy, which is to minimize exploitation, wasteful, and unscientific management of natural resources; to preserve and improve soil stability and productivity; contribute to the social needs and continuous and stable supply of food, fiber, and timber products through economic use and conservation of the land; to promote land use functions that result in no net loss of wetlands; and to protect and enhance threatened and endangered species habitats.

Installations accomplish these responsibilities by implementing an Integrated Natural Resources Management Plan (required by the Sikes Act). The plan includes programs to inventory, delineate, classify, and manage all applicable

natural resources to include: wetlands, scenic areas, endangered and threatened species, sensitive and critical habitats, and other natural resources areas of special interest. There are a series of memorandums of agreement and cooperative agreements that provide Army installations with assistance in natural resource management. These include arrangements with the Forest Service, National Park Service, the USFWS , and The Nature Conservancy (TNC). TNC can provide technical assistance and study significant ecosystems under Army control.

Other management techniques required by the regulation are Integrated Training Area Management (ITAM), Integrated Pest Management (IPM), and Endangered Species Management Plans (ESMP). In its discussion of the development of ESMPs, the regulation does mention the use of cooperative agreements with outside entities. This area needs to be expanded, providing more guidance on installation specific cooperative agreements for achieving natural resource management goals.

### **2.2.3 AR 210-20**

Policy, procedure, and responsibilities for the development, content, submission, and maintenance of the Real Property Master Plan (RPMP) are found in AR 210-20 *Master Planning for Army Installations* (DAEN-ZCI-P 1993). The installation must plan for the 21<sup>st</sup> century and respond to future Army missions and community aspirations, while providing the capability to train, project, sustain, and constitute today's force. The RPMP is the instrument for unifying installation planning and programming. The RPMP consists of four components: the long-range component (LRC), capital investment strategy (CIS), short-range component (SRC), and the mobilization component (MC) and forms the long-term investment strategy for the installation's built environment. The objectives of the RPMP are to:

- determine real property deficiencies and identify cost
- relate installation development to local community development
- support military construction and real property maintenance activities
- identify activities and actions that have environmental impacts and incorporate the requirements of NEPA
- balance real property with mission requirements
- complement environmental, historic preservation, and natural resource management plans.

Installations are to work with local and regional planning agencies to foster close and harmonious planning relations with adjacent communities. The desired coordination should result in:

- minimum impacts of installation operations and development on local communities
- determination of future growth patterns and development of the surrounding communities
- mutually compatible land uses and zoning to assure future installation viability.

The regulation also recommends the use of Joint Land Use Studies (JLUS) and Air Installation Compatible Use Zone (AICUZ) studies. Section 2.3 gives more detail on JLUS.

The RPMP is the installation's plan for management and development of the installation's real property resources. It is supposed to analyze and integrate the plans prepared by various installation components and the surrounding communities to provide for orderly development. A complete RPMP forms the foundation for the development and facility management activities on an installation.

#### **2.2.4 AR 210-21**

Policy, procedure, and responsibilities for Army range and training land acquisition are found in AR 210-21 *Army Ranges and Training Land Program* (DCSOPS 1997). This regulation defines the Army's program to standardize the training land acquisition process and provide guidance for determining live fire and maneuver land acquisition requirements. The Ranges and Training Land Program (RTLTP) planning process is based on three primary considerations: mission support, environmental stewardship, and economic feasibility. The goal is to achieve a balance between the effective use of available training lands and compliance with environmental laws. Integrated Training Area Management (ITAM) serves as the environmental linkage to the RTLTP and comes under the umbrella of the INRMP.

#### **2.2.5 AR 405-10**

The acquisition of real property is tightly controlled within the Federal Government and only Congress has the power to authorize it. AR 405-10, *Acquisition of Real Property and Interest Therein*, defines the appropriate priorities and conditions for acquiring land (DAEN-REA 1970). The purchase of land is a last resort with strict requirements and other acquisition methods must be considered prior to purchase, lease, or condemnation. Addressing environmental issues may not be considered sufficient justification for land acquisition, although easements may be a viable option.

## 2.3 Private Property Issues and Easement Opportunities

Private property is a social and legal institution that is set forth in both common law and property codes that assigns the control of resources, including land, buildings, and personal items. It also refers to financial assets and labor skills and intellectual powers. Private property laws provide owners with the right to possess, use, enjoy, exclude non-owners, sell, transfer, will to heirs, and to receive profits and rents from any legal use of property (Jones and Gilliland 2002). Historically, most property originally owned by the Federal government has been transferred to individuals. Certain sovereign rights were reserved for the public and these public rights restrict private property rights.

Public rights are exercised by government and include four categories:

1. *Police Power*—the right to regulate private property use for protecting the public interest
2. *Eminent Domain*—the right to take private property for the public interest on payment of just compensation
3. *Taxation*—the right to tax private property to support public needs according to constitutional and statutory law
4. *Escheat*—the right of the state to acquire title to private property if a property owner dies without a will or heirs.

These public rights both protect and limit the property rights of private owners. In the last decade there has been considerable public debate over whether the enforcement of environmental regulations should be considered a condemnation or a taking (requiring just compensation) or are applications of police power (designed to prevent uses of resources that are harmful to public interests). The two most controversial laws where these issues are in contention are the Endangered Species Act and Clean Water Act. Dozens of private land associations or groups being founded to counter the police power theory and demand just compensation. These groups are active in all areas of the nation and many are concerned about the very issues that the Army considers encroachment. It should be noted that some of these groups are opposed to almost any governmental initiative including conservation easements, especially if they restrict hunting or fishing.

Owning property is actually owning a bundle of rights and the exchange of goods is not so much trading objects as exchanging the bundle of right to those objects. This bundle of rights is often referred to as property rights—meaning rights *to* property and not rights *of* property (Allen 1987). Since property is a bundle of rights, an owner may donate, sell, or otherwise transfer some of these rights to another party. Examples of rights that are typically sold are water and mineral

rights. Development rights to property may also be transferred. These generally fall under the term of conservation easements. A conservation easement is a deed restriction landowners voluntarily place on their property to protect resources such as productive agricultural land, ground and surface water, wildlife habitat, historic sites or scenic views (Mill 1998). Landowners (grantors) use conservation easements to authorize a qualified conservation organization or public agency (grantee) to monitor and enforce the restrictions set forth in the agreement. Conservation easements are flexible documents tailored to each property and the needs of individual landowners. They may cover an entire parcel or portions of a property. The landowner usually works with the prospective grantee to decide which activities should be limited, to protect specific resources.

## **2.4 Current Approaches to Encroachment Mitigation**

There are not many avenues available to an installation for addressing the issues of encroachment. The two current initiatives are joint regional planning studies and cooperative agreements for land buffers and conservation easements.

### ***2.4.1 Joint Land Use Study (JLUS) Program***

The Joint Land Use Study (JLUS) Program of the Office of Economic Adjustment, Department of Defense, is a cooperative planning initiative in which military and civilian communities can anticipate the potential for land development conflicts and avoid the encroachment problem (DoD 1995). When the public and communities are exposed to noise and accident potential, they will seek relief. This typically places pressure on the military installation to modify operations. In extreme cases it could ultimately lead to total elimination of noise generating activities, a reduction in personnel and mission assignments and reduced economic benefits to the community. In such cases, both parties lose. However, if adjustments are made on both sides of the fence, both parties can be winners.

The JLUS program was initiated in 1985 and was designed to provide financial and technical incentives to help resolve conflicts that occur between mission objectives and community growth patterns. The intent of a JLUS is to develop a plan as the basis for implementing land use recommendations around a military installation. The fundamental objective is to protect community health, safety and welfare, and the military mission. Implementation measures may include amending building codes to require added sound attenuation, land exchanges, fair disclosure of noise levels to property buyers, or traditional development controls like zoning, subdivision regulations, height restrictions, and other measures.

Army installations determine whether they are experiencing serious incompatibilities or are likely to have increased encroachment from surrounding development that will adversely affect the mission operation. The installation may then nominate itself through command channels for a JLUS. The Department of Defense, Office of Economic Adjustment (OEA) evaluates the nominees for participation in the program (Dempsey 2001). The community or communities are then offered the opportunity to embark on a JLUS. The objective is to fix the problem before it gets worse or, best of all, before it occurs. The financial incentive is cost-shared grants that are made available through the OEA, Community Planning Assistance Program.

An important ingredient to a successful JLUS is community consensus. Each local governing body within the proposed JLUS area must agree with the need for compatible growth around the military installation. If the JLUS is to have positive results, the communities must also agree to adopt the measures needed to achieve compatible growth. Success assumes that both the military department and the community see a long-term benefit from the JLUS program and sustained economic activity that continued presence of the installation assures.

Once there is consensus that a JLUS is desirable, the community or communities must decide what body or sponsor will serve as the focal point for the study. This can be any public organization, like a community planning office, a regional planning agency, or a council of governments. The sponsor must develop a scope of work that outlines the contents of the study, including goals and objectives, components of the study, methods of public involvement, and a plan of implementation. The scope also includes an estimate of cost, including the amount of funds or in-kind resources that will be pledged by the sponsor. The actual study and analyses can be done by either in-house staff or by contract.

A JLUS is usually completed in a year, although the degree of coordination and complexity may dictate that a longer period of time is needed to achieve the necessary consensus and commitment to implementation. Through the JLUS process, communities voluntarily adopt land development controls to implement the plan and assure the overall goal of mutually beneficial coexistence is achieved.

#### ***2.4.2 JLUS as an Effective Mitigation Tool***

Historically, the JLUS program was mainly used by the installations with flying missions. Army installations did not have a significant impact on neighboring communities until development and population pressures placed the surrounding communities in closer proximity to military operations. With encroachment issues growing over time, a JLUS presents opportunities that an increasing

number of Army installations should be investigating and using. The joint study program requires efforts from both the surrounding community and the installation. Joint planning is part of the solution to encroachment issues from both exogenous urban growth and landuse change, in general.

Experience from these studies shows a high success rate. The JLUS efforts have the potential to spawn mutual benefits, some beyond those directly anticipated. Common benefits include:

- protection of the health and safety of residents near military installations from the impacts of military operations
- preservation of the long-term compatibility of the installation and the community surrounding it
- greater emphasis on community comprehensive planning
- increased cooperative spirit between the installation and local officials
- integration of community comprehensive plans with the installation, and when the JLUS involves several jurisdictions, with one another.

### **2.4.3 Cooperative Agreements for Land Buffers and Conservation Easements**

Today's modern regulatory and resource constrained climate increasingly works against cross-boundary regional cooperation. The U.S. Army Environmental Center has developed a new use for an old tool, the Cooperative Agreement (CA), for addressing these needs (Farley and Belfit 2001). The CA has been proven effective in joint land management. The CA enables joint ventures with external organizations, including cost-sharing the acquisition of conservation encumbrances. Conservation encumbrances are fee simple land purchases or the purchase of perpetuity deed restrictions. All acquisitions are done with willing sellers and based on fair market values of the acquired assets. The acquisitions may also provide for low impact soldier access to the conserved lands. Under a CA, ultimate ownership of the land rests with the partner and not with the Army. With ownership, passes the long-term natural resource management responsibilities for the property. The CA approach has been successful in reducing both encroachment pressures by incompatible development in the vicinity of a military installation and relieving training restrictions due to environmental compliance. Under limited circumstances, this tool can provide long-term security of military missions and declining natural resources.

The current use of the CA for conservation encumbrances is authorized under the Sikes Act, as amended by the *Sikes Act Improvement Act* of 1997. The Act (16 U.S.C. §670c) provides: “[t]he Secretary of a military department may enter

into cooperative agreements with States, local governments, nongovernmental organizations, and individuals to provide for the maintenance and improvement of natural resources on, or to benefit natural and historic research of Department of Defense installations.” U.S. Code (31 U.S.C. §6305) further states that

[a]n executive agency shall use a cooperative agreement as the legal instrument reflecting a relationship between the United States Government and a State, a local government, or other recipient when the principal purpose of the relationship is to transfer a thing of value to the State, local government, or other recipient to carry out a public purpose of support or stimulation authorized by a law of the United States instead of acquiring (by purchase, lease, or barter) property or services for the direct benefit or use of the United States Government; and substantial involvement is expected between the executive agency and the State, local government, or other recipient when carrying out the activity contemplated in the agreement.

These two sections of the U.S. Code lay out the bounds of the current use of cooperative agreements. The important concept to note is that these agreements are not limited to acquisition of conservation encumbrances, but can be creatively applied to other agreements that enhance installation natural resource posture or mission viability.

#### ***2.4.4 Cooperative Agreements as an Effective Mitigation Tool***

Expanding cooperative partnerships, purchasing lands, securing easements, and transferring development rights will help resolve Army training encroachment problems. The next section presents proposed new legislation to expressly permit the use of CAs to help mitigate the consequences of encroachment or other constraints on military training, testing, and operations. Three case studies (described in Chapter 3) show concrete and effective applications of the CAs.

## **2.5 Proposed Enabling Legislation**

Legislation for clearly enabling the use of cooperative agreements to address encroachment and other constraints on military training, testing, and operations has been proposed for inclusion in the FY2003 Defense Authorization Bill. The legislation proposes to amend Chapter 159 of Title 10, United States Code to allow the Secretary of each military department to enter into agreements with any State, territory, or possession, or local government thereof; any Indian tribe; or any private organization that has the conservation, restoration, or preservation

of land and natural resources, or a similar objective, as the organization's stated purpose or goal. The purpose of any agreement under the proposed legislation is to address the use or development of real property in the vicinity of military installations to limit or prevent encroachment, prevent interference in the use of military lands, and alleviate existing or projected restrictions that may have the potential to impede military training, testing, or operations. Chapter 63 of title 31 shall not apply to agreements entered into under the proposed legislation.

An agreement under the proposed legislation may provide for the non-Federal entity to acquire, on a cost-shared basis, all right, title, and interest in real property, or any lesser estate or interest; and, with respect to any real property estate or interest so acquired, provide for the non-Federal entity to transfer to the United States, on request at any time, an estate or interest in such real property. Such interest is limited to that interest necessary to permit the United States to ensure that the property is used and managed only in a manner that does not restrict, impede, or otherwise interfere with, directly or indirectly, current and future military training, testing, and operations. The Secretary concerned shall determine what estate or interest is necessary. Notwithstanding any other provision of law, the military department is authorized to accept such estate or interest in real property on behalf of the United States. Additionally, funds appropriated for operations and maintenance of the Department of Defense or of any military department, including funds appropriated to support the Legacy Resources Management Program, may be made available to execute these agreements. For installations or facilities operated primarily with funds appropriated for research, development, testing, and evaluation, those funds may be used in lieu of funds appropriated for operations and maintenance.

The proposed legislation also allows the requirement of such additional terms and conditions in the agreements considered appropriate to protect the interests of the United States. Real property may not be acquired under this legislation unless the owner of the property consents to the acquisition (the power of eminent domain or condemnation is not authorized). Appraisals or title documents prepared or adopted by a non-Federal entity may be accepted as satisfying the applicable requirements of 42 U.S.C. 4651 or 40 U.S.C. 255 where the appraisals or title documents substantially comply with Federal standards.

The use of land acquired under this act, including any military uses, would be clearly defined in the agreement and subject to NEPA for analysis of environmental impact. Typically, a conservation easement would not include the right to conduct military operations on the land. Land uses that affect the conservation value of the site would be a disincentive to potential conservation-minded partners.

## 3 Encroachment Mitigation Case Studies

Existing examples of Army installations reaching outside the fence line to mitigate encroachment impacts are limited, but momentum is growing and patterns of success are developing. Much of the effort to date has focused on natural resource issues, particularly as relates to threatened and endangered species management and the requirements of the Endangered Species Act (ESA).

The ESA directs the Secretary of the Interior, through the U.S. Fish and Wildlife Service (USFWS), to establish and maintain a list of species in danger of extinction, to identify the habitat necessary for their conservation, and to develop a plan that will result in recovery of the species (16 U.S.C. §1533). The ESA protects listed species by imposing an outright prohibition on their “taking” without the express authorization of the USFWS.

The ESA requires that Federal agencies bear the primary burden of protecting, conserving, and recovering species on the brink of extinction. Federal agencies are prohibited from going forward with any action that is likely to result in “jeopardy” of any listed species (16 U.S.C. §1536). Like private individuals, Federal agencies may not “take” listed species without authorization from the USFWS. Unlike private individuals, Federal agencies have the duty to conserve listed species. “Conservation” is defined as: “the use of all methods and procedures which are necessary to bring the listed species to the point at which the protections of the Act are no longer necessary (16 U.S.C. §1532). Effectively, Federal agencies are responsible for bringing species back to recovery where they can exist as viable self-sustained populations.

The following sections summarize the conditions and circumstances of encroachment that were threatening military mission sustainability at three installations, and their approaches to mitigation with off post solutions.

### 3.1 Fort Bragg, North Carolina

#### 3.1.1 Background

Fort Bragg is the home of the XVIII Airborne Corps and the 82<sup>nd</sup> Airborne Division, and is the Army’s premier power projection platform. It is also home to five

listed endangered species. A particular challenge is the red-cockaded woodpecker (RCW), a species that made the endangered list in 1970. Fort Bragg's RCWs are the second largest population in the southeastern states and are considered one of only 15 disjointed population groups that are critical to the revival of the species, as per the USFWS species recovery plan (1985). The most significant issue in RCW decline is loss of habitat: this species is dependent on southern pine woodlands, once an abundant ecosystem that has been largely eliminated due to human-induced landscape changes. Fort Bragg is located within the North Carolina Sandhills ecoregion and contains the largest contiguous parcel of RCW-suitable habitat therein.

Though Fort Bragg entered into consultation with USFWS for RCW management in 1988, they failed to recognize the potential impacts of non-compliance with the ESA. Training practices then in place resulted in the issuance of a jeopardy biological opinion against the installation in 1992, which not only established Fort Bragg's responsibility to aid in species recovery, but also resulted in significant restrictions on land use.

From this unfavorable position, Fort Bragg went to work almost immediately to promote conservation stewardship. In cooperation with the USFWS, Fort Bragg developed guidelines for managing RCWs on all southeast regional installations. These initial guidelines cost Fort Bragg about 12,000 acres in land use restrictions, and a serious degradation in training realism. In 1996, the guidelines were revised through renegotiation with the USFWS and execution of environmental and biological assessments to ensure that changes would not have a negative impact on recovery. The effect was a drop in restrictions to about 5,000 acres and improved research and monitoring on post.

### **3.1.2 Initiative: Regional Conservation Partnering**

Fort Bragg and USFWS immediately recognized that recovery could not be achieved only with on-post conservation. While the other 14 RCW groups were completely housed within Federal land holdings, the North Carolina Sandhills population was distributed across a mosaic of Federal, state, and private lands. To promote coordinated stewardship, in 1992 Fort Bragg hosted a 2-day conference on RCW issues, with attendance from other Federal, state, and academic agencies and local interest groups. The next year they assisted in establishing a working group to advance a long-term commitment to regional planning. This working group evolved into the North Carolina Sandhills Conservation Partnership (NCSCP), with ecosystem management directives and proactive interest in including all stakeholders to reach comprehensive solutions for the region. The

Army also provided funding to establish a Sandhills field office of the USFWS and support an RCW recovery coordinator.

### **3.1.3 Initiative: Sandhills Private Lands Initiative**

In 1995 Fort Bragg conducted a Land-Use Requirements study and identified a total training area shortfall of approximately 76,000 acres (determined based on acreage needed to support the single-largest training event and excluding non-contiguous training land subject to restrictions). This information provided the incentive to find creative ways to effectively manage RCW recovery not only to prevent additional training restrictions, but also to reduce current restrictions. While the regional partnering efforts would eventually promote improved ecosystem and land use sustainability, it was unable to halt the on-going habitat losses on private lands from continuing human uses. Fort Bragg was willing to take direct initiative off post to prevent habitat conversions, but did not have sufficient funds, expertise, or authority to pursue land acquisition.

A solution was crafted with the expertise of the Army Environmental Center (AEC) and The Nature Conservancy, an Army conservation research and land management partner since 1988 (Farley and Belfit 2001). The Sandhills Private Lands Initiative is a cooperative agreement (CA) joining Fort Bragg, AEC, and TNC to provide conservation of RCW habitat on private lands in the vicinity of Fort Bragg. The CA was first established in 1995 for a 5-year life span, and has undergone some modifications and renewal. The basic approach is for both the Army and TNC to provide funding for the purchase of private lands, from willing sellers, that currently contain or are suitable for restoration of the RCWs preferred pineland habitat. TNC manages the real estate transaction, retains the deed to any purchased property, and manages the land in perpetuity. There is also a provision in the CA for Fort Bragg to have access to acquired properties to conduct non-impact military training.

Because of its specific conservation mandate, the CA could be executed under authority of the Sike's Act (the CA can be considered to effect improvements to natural resource management on the installation). The initial cost sharing was \$2 of Army funding to \$1 of TNC funding, but has been amended to a \$1 to \$1 ratio. Both TNC and Army personnel are involved in site selection and evaluation of properties suitable for purchase, with consultation from a land acquisition subcommittee from the NCSCP. Each prospect is evaluated, benefits of the site to the different parties are identified, and a decision to proceed with purchase negotiation is made only when both Fort Bragg and TNC are in agreement. The purchasing mechanism (fee simple, easements) can vary for each transaction, based on the seller's situation and the interests of TNC and the Army.

## 3.2 Fort Hood, CO

### 3.2.1 Background

Fort Hood is host to several endangered species. Of particular importance to this conservation partnerships investigation is the initiatives that arose from management concerns regarding the black-capped vireo. This songbird was first identified on Fort Hood in 1985, and inventory, monitoring, and research efforts commenced in 1987. That same year the species was listed as endangered, and the USFWS issued its species recovery plan in 1991. In 1993 USFWS issued a nonjeopardy Biological Opinion (BO) for Fort Hood, but stipulated activities to: mitigate against expected incidental take; and assist in species recovery by reducing habitat loss and nest parasitism (the two most significant causes of vireo population decline).

Parasitism is caused by cowbirds, an avian species that lays its eggs in the nests of the vireos and many other avian species. Installation-sponsored efforts aimed at understanding and reducing the parasitism problems were already underway by 1987. These early studies showed that the presence of cowbird nestlings in vireo nests has a particularly significant negative impact on the survival rates of vireo nestlings. Without immediate intervention, the local vireo population would likely become extinct within 10 years. After the issuance of the BO, Fort Hood contracted with TNC of Texas to expand research and monitoring of the birds on post. The coordinated team of biologist from Army, TNC, and USFWS were able to expand studies and initiate efforts to reduce parasitism. By 1994, the combined effect was an immediate and dramatic drop in parasitism rates and corresponding increase in nesting success.

### 3.2.2 Initiative: Conservation Research Partnership

Given the success of the collaboration, in 1997 the DoD and TNC entered into a 5-year cooperative agreement for continued research and conservation actions. The agreement established the Fort Hood Center of Cooperative Ecological Research, provided for DoD funding support to TNC biologists, and ensured continuity of research efforts. The focus of efforts at the Center are largely to address the terms and conditions of the USFWS Biological Opinion that relate to the management and protection of endangered species within Fort Hood's multiple-use objectives. The research benefits management planning for vireo populations across its range.

This has proven to be a successful and mutually beneficial partnership. Fort Hood gains scientific expertise and broader access to academic research associa-

tions. They demonstrate proactive natural resource management that responds to requirements for compliance with the ESA. These efforts may have contributed to a recent (2000) update to the BO, relaxing some training restrictions and providing for demonstration that military maneuvers can be compatible with vireo management. TNC has gained significant knowledge and applied management techniques that can be used to protect these species in related sites.

The reduction in parasitism was accomplished with the trapping and removal of cowbirds from Fort Hood training areas where concentrations of cowbirds were likely to occur. Because the cowbird population is resilient and cowbirds favor the grazing lands on Fort Hood, trapping on the installation must continue to maintain successful vireo breeding. During the peak breeding months of March through June, intensive effort is needed to maintain parasitism levels below the 10 percent required by the BO. During the remainder of the year (July through February) trapping continues both as a population control measure and an educational awareness technique for troops training in the field.

### **3.2.3 Initiative: Central Texas Private Lands Conservation Practices**

A second initiative following on the findings of the research partnership is the Central Texas Private Lands Trapping Initiative. This initiative was established in March of 1999 in a Memorandum of Understanding between the USFWS, Texas Parks and Wildlife Department (TPWD), Texas Department of Agriculture Wildlife Services (WS), Central Texas Cattlemen's Association (CTCA), and Fort Hood. It describes the actions and responsibilities for a cowbird-trapping program, similar to that conducted on Fort Hood, to be conducted on private lands adjacent to the installation.

The CTCA is a cooperative representing the 83 families whose land was taken by the establishment of Fort Hood in the 1940s. The CTCA is the unified entity through which these families acquire and manage a grazing outlease for 182,000 acres on Fort Hood. This was started as a noncompetitive 5-year lease in 1954 and has been consistently renewed every 5 years. The CTCA's motivation for participation in the Trapping Initiative arose from evolving conservation strategies on Fort Hood. The Natural Resources Management Branch was planning to restrict grazing in core vireo habitat areas and potentially reduce the amount of stock allowed through the lease. A compromise offered by the CTCA was for the implementation and management of trapping efforts on private land adjacent to these critical areas in exchange for continued grazing access. This approach was agreed on as long as parasitism rates in these critical areas remain below 10 percent each season. The CTCA provides 27 traps, operational from March

through May, with the WS serving as trap administrators. Fort Hood monitors nest parasitism on the installation.

It seems that the memorandum of understanding (MOU) was implemented as a short-term measure to reduce logistical conflicts between disparate interest groups who were competing for a single resource: Fort Hood training lands. The aggressive research and management techniques undertaken to comply with the ESA were leading towards a conclusion that vireo nesting habitat and cattle grazing were incompatible in the long term. Concurrent studies for training lands sustainability were also finding that the combination of grazing and military maneuvers were placing too much stress on the landscape in terms of soil erosion. The larger issue of reducing or, potentially, completely eliminating the outlease program was too politically charged to resolve in the short timeframe available to ensure meeting the requirements of the BO (the negotiations were taking place in February and March, approaching the critical trapping timeframes for the upcoming nesting season). The MOU at least ensured that all Fort Hood land users and managers were aware of the requirements, were working cooperatively to meet them, and were held accountable for compliance. Because it has been included in the BO, the MOU will remain in effect until the longer-term issues with the grazing outlease are resolved.

There are some tangential benefits arising from this Initiative that are worth noting. Because of the recognized conservation benefits affected by the Fort Hood trapping program, trapping on private lands is being promoted throughout the state. TPWD and the Texas Agriculture Experiment Station included these activities as qualifying management actions for landowners to receive a beneficial agricultural appraisal status. The TPWD established a protocol for administering a statewide trapping program, which as of 2000 had 200 functioning traps in the field and 150 landowners on a waiting list to participate.

### **3.3 Fort Huachuca, Arizona**

#### **3.3.1 Background**

Fort Huachuca is located in the Upper San Pedro River Basin. This watershed, centered on a river system that originates in Mexico and travels north into Arizona, represents a transition area between the Sonoran and Chihuahuan deserts and is internationally known for its biodiversity. It supports the second highest land mammal diversity in the world and provides habitat for almost 400 bird species. In 1988, the riparian zone in Arizona was acquired by the U.S. Depart-

ment of the Interior and is managed as a National Conservation Area (SPNCA) by the Bureau of Land Management.

Fort Huachuca is host to an endangered plant, the Huachuca water umbel; the SPNCA hosts the water umbel, the endangered southwestern willow flycatcher, and other species of concern. The critical factor influencing conservation of all the riparian species is the availability of appropriate habitat such as in the SPNCA. By defining the SPNCA as the riparian zone adjacent to the River, it was thought that this habitat could be protected. Continuing research found that the riparian vegetation was dependent on not just the surface waters of the San Pedro River, but also the groundwater of the surrounding watershed. Water consumption from human uses and irrigated agriculture were resulting in a net decrease in groundwater availability and negative impacts on riparian vegetation sustainability. In 1999 the USFWS issued a nonjeopardy biological opinion regarding endangered species conservation for Fort Huachuca, but with stipulations that the installation work aggressively to reduce water use both on and off post.

Fort Huachuca is being held accountable for off post water usage because it is considered the primary source of urbanization pressures in the watershed. It is currently the largest employer in the area, it attracts a large contingent of military retirees, and it has expectations of continuing growth as a result of realignment and integration with National Guard facilities. Sierra Vista, located adjacent to Fort Huachuca, is the largest community in the watershed with a population of 40,000. While this does not seem to present the same degree of urbanization impacts that other installations face, Sierra Vista's 2 percent annual growth rate is too aggressive to be supported by the watershed's limited water resources.

A 1998 report estimated the water deficit for the watershed at 7,000 acre-ft annually. The BO makes Fort Huachuca responsible for reductions to this deficit of 1,755 acre-ft on post and 3,105 acre-ft off post within 10 years. To ensure on-post improvements, Fort Huachuca has developed an Army Water Resources Management Plan. Plan implementation involves both small and large scale efforts such as employing only low-water use appliances and developing a new water treatment plant to return treated effluent to the aquifer. For off post efforts, Fort Huachuca is working with the Upper San Pedro Partnership (USPP), a collaborative of more than a dozen governmental organizations and TNC, to develop a Regional Water Resources Management Plan and support research in the watershed.

### **3.3.2 Initiative: Private Lands Water Conservation Easements**

While the regional planning efforts would set a long-term direction, Fort Huachuca needed to respond to the BO with direct actions for more immediate reductions to current uses off post. A number of practices helped point the way to a collaborative effort for private lands conservation easements. The BLM had been using conservation easements to help control water use and future development on private property in the region, by either acquisition or by the exchange of grazing rights on BLM property. Regional studies showed that irrigation agriculture was a major water use and a potential source for significant reductions. The Fort Bragg / TNC / USFWS collaboration presented a great example that speeded the process to establish a collaboration between Fort Huachuca, TNC, and the BLM.

This private lands cooperative agreement just came into effect for FY 2002. Fort Huachuca and TNC conducted an environmental assessment to document the expected effects of the program before proceeding with funding and finalizing the agreement. The Army secured \$1M from an environmental program for the purchase of conservation easements. TNC will act as broker for the transactions, working with willing sellers either to acquire property outright, subsequently reselling it with easements in place, or negotiate easements with the existing owners. Each easement will likely be different, depending on the characteristics of the land and the interests of the property owner. The BLM will be the easement holder and responsible for ensuring the landowners comply with the easement restrictions over time. Targets for acquisition are property within 5 miles of the San Pedro River and with current water uses that can be retired or drastically reduced (particularly irrigated agriculture).

Because of growing awareness of the regional water resource issues and the multi-agency collaborative evolving with USPP, there appears to be substantial support for the initiative. However, there are a couple of regional organizations that object to the approach. One is the Coalition of Arizona/New Mexico Counties, a conservative property rights group that is arguing that Fort Huachuca's conservation easement initiative is bypassing the role of local elected officials without any statutory or policy directive and has the potential for removing or devaluing property from the county tax rolls. There continues to be distrust of the impact and intent of government land ownership, and this extends to partial (easement) ownership. The Coalition threatened a potential lawsuit to prevent the initiative from moving forward.

### 3.4 Lessons Learned from Case Studies

The three case studies above provide a picture of the Army's experience with cooperative agreements for habitat and water conservation easements and conservation practices. They were undertaken to mitigate encroachment issues that were or will be affecting the installations' ability to carry out their missions. Several key were points were demonstrated:

- CAs are effective in resolving land use conflicts around military installations by effecting change in the use and development of private land.
- CAs are flexible and their expanded use within the Army and other military Services should be investigated and promoted.
- CAs should be used in concert with larger regional ecosystem planning, conservation management initiatives, and regional planning initiatives.
- CAs are initial mechanisms that ensure opportunities for natural resource conservation, management, and long-term sustainment are preserved, while comprehensive regional landuse strategies are implemented.
- CAs that result in easements and permanent land ownership changes solidify in perpetuity the commitments made in the planning process.
- Since the results are enduring, the approach used in the CA must be well vetted within the region and all stakeholders identified and brought into the process.

Cooperative Agreements may not be useful at all Army installations; they have a high cost and are long-term in nature. Before investing significant scarce resources, installations must carefully consider the potential of successful implementation. The CAs reviewed above are succeeding in reducing respective encroachment issues because:

- They result from long-term participation in an expensive and time-consuming process of bioregional planning. An interagency decisionmaking body must be formed along with the interpersonal relationships that make it effective.
- There is a strong foundation of scientific knowledge regarding the conservation management of the region's natural resources available to support the planning team.
- The Army's position is still viable and it is not too late to intervene to protect significant natural resources on adjacent lands.
- The land values in the vicinity of the installations have not reached extremely high levels.
- Multiple public and private entities in the region are also experiencing impacts from compliance with a conservation laws and/or land development so

multiple stakeholders benefit. Therefore, each partner gets a return on investment.

- The action taken has the potential to serve multiple public purposes (e.g. endangered species recovery, ecosystem conservation, increased grazing, water conservation, reduced encroachment, increased soldier training, and recreation).

Effective use of CAs to solve other land use conflicts around Army installations requires that the Army reconsider its attitude towards conservation. The Fort Bragg Private Lands Initiative experience revealed that conservation of natural resources and sustainment of military training ranges are complementary (Farley and Belfit 2001). This opportunity resulted from the foresight and commitment of the military and civilian leadership at Fort Bragg and their willingness to take an innovative approach that many did not consider viable. Enlightened management of military lands can win public support as demonstrated by the CAs shown above and results from Air Force training range management practices (McCall 2001).

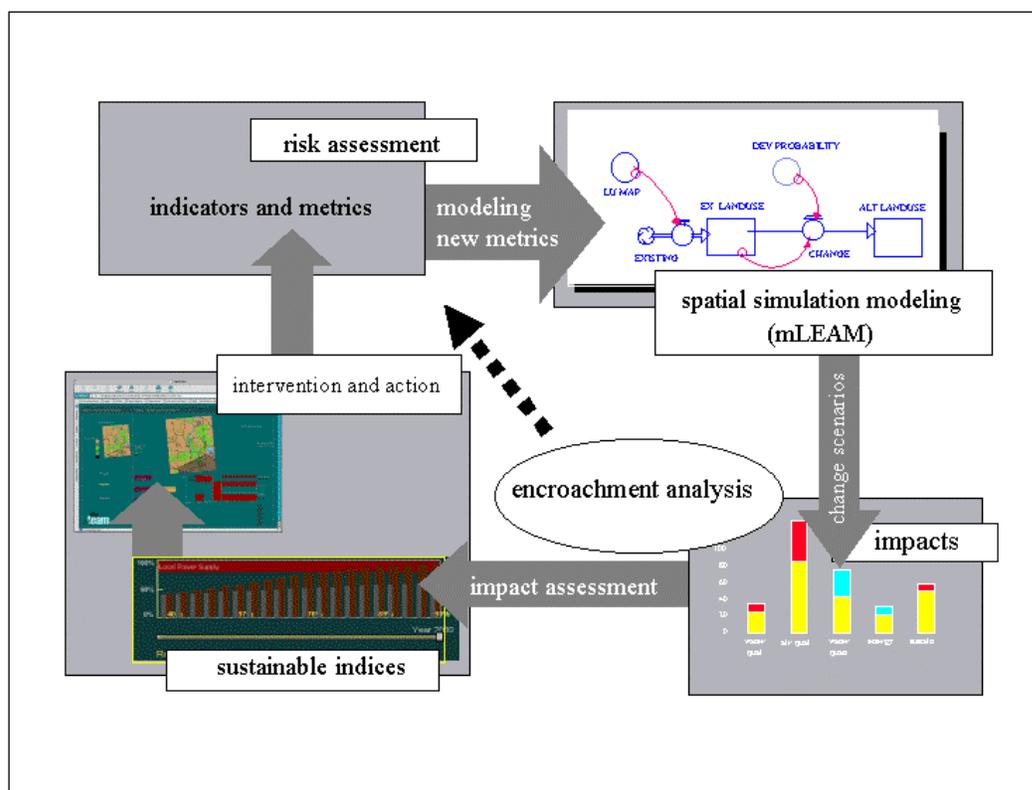
## 4 Recommended Approach to Encroachment Mitigation

Encroachment must be managed by a proactive, not reactive, process. Responding to litigation and jeopardy opinions is not an effective method of ensuring mission sustainment. Solving the encroachment issue is a multi-step process that starts with determining need through characterizing installations at risk, prioritizing those installations requiring action, strategizing what action should be taken, and actively pursuing those actions. **Figure 1** shows the encroachment management process. The sections that follow describe each step and related tools.

The first step in a proactive methodology is to characterize both endogenous and exogenous risks to military installations. This study proposes a uniform risk assessment with a broad set of indicators covering the range of issues that affect all DoD installations. The standardized approach would aid in prioritizing installations that should undertake encroachment related actions both from a preventive and ameliorative viewpoint to ensure long-term mission sustainment.

The second step is to strategize what actions should be taken with a scenario-based planning approach. This is facilitated by the Military Land use Evolution and Impact Assessment Model (mLEAM), a simulation tool that is customizable to the unique issues and interests of each installation's regional setting. mLEAM results provide spatial and temporal scenarios that indicate how land use change and effective policy intervention can mitigate regional stressors.

Based on the impacts of landscape changes evaluated with mLEAM, an installation can pursue encroachment mitigation actions. Local data, collected for mLEAM and other specific investigation needs, informs the intervention process and policy development. Off-post mitigation actions consist of two focuses: land use mechanisms reached through joint regional planning initiatives with surrounding communities; and cooperative agreements (CA) to carry regional ecosystem planning, habitat acquisition, and land use encumbrances by third parties to expand the capacity of ranges and training lands. Combinations of both strategies may be viable and required to achieve concrete on-the-ground action.



**Figure 1. Encroachment management cycle.**

It must be emphasized that an evaluation of risk is required to proactively address encroachment issues before they become major problems that impact mission accomplishment. The best time to intervene is before options are reduced and land use changes outside the installation boundaries have led to more constrained solutions. Many installations are already experiencing encroachment related issues. This methodology of assessing risk, determining priorities, and taking informed actions will point the way to effective intervention strategies.

#### 4.1 Determine Needs through Risk Assessment

The encroachment issue is multifaceted and requires an integrated approach determined by evaluating the combination of endogenous and exogenous risks and prioritization of those risks. The effects of demographic change, community growth and sprawl, and regional economic vitality may define levels of exogenous risk while issues associated with installation mission, management, and cultural and natural histories define endogenous risk. Determining the level of both endogenous and exogenous risk entails the development of set of indicators that can provide reliable information about the level and type of installation risk exposure.

#### **4.1.1 Overview of Indicator Framework and Development**

An “indicator” is a piece of information that reflects what is happening in a larger system. It allows observers to see the big picture by looking at a smaller part of it. Indicators are often quantitative measures such as physical or economic data. For example, traditional indicators such as inflation and unemployment are used for making economic decisions. Indicators are widely used as a tool for monitoring progress and to simplify, quantify, and communicate complex issues. Multiple indicators are sometimes aggregated into an index, usually for comparison across locations or to indicate change over time. Indicators are the feedback mechanism required to drive policy changes intended to improve the situation being measured.

Indicators are used despite being widely acknowledged to be inadequate as true measures of progress because they fail to address environmental and social consequences. Broader sets of indicators are needed to define an issue and inform policy. Those engaged in indicator development agree that indicators should be tailored for the locale and the target audience. The idea of participatory development by a group of local stakeholders is also widespread.

Because the process of measuring focuses attention on the impact, it makes a great deal of difference what is measured and how it relates to what we wish to measure. Developing indicators is a six-step process (Maclaren 1996):

1. Define and conceptualize the goals for which indicators are needed.
2. Identify the target audience, the associated purpose for which indicators will be used, and the relative number of indicators needed.
3. Choose an appropriate indicator framework.
4. Define indicator selection criteria.
5. Identify a set of potential indicators and evaluate them against the selection criteria.
6. Choose a final set of indicators and test their effectiveness.

A framework for developing a set of indicators is necessary for every indicator effort. Maclaren’s recommended frameworks are goal-based, domain-based, issue-based, sectoral, and causal. They may also be a combination two frameworks. A goal-based framework is predicated on the development of goals. Indicators are then created for each goal. A benefit of this framework is that there are fewer indicators. A weakness is that it does not capture linkages among the dimensions of the issue. A domain-based framework is based on the key dimensions of the issue like environment, economy, and society. Indicators are identified for each dimension. This framework is effective at ensuring that the key dimensions of the issue are covered. A weakness of this framework is that indi-

cators are not linked to goals. An issue-based framework is based on definable issues such as sprawl, crime, industrial pollution, solid waste management, or encroachment. Sectoral-based indicators are defined by different sectors in the economy. Causal-based indicators are developed within a framework of conditions, stresses, and responses using composite indicators for each condition based on a set of stressors. Relief of the stresses points to the solution for the stress or risk.

The difficulty in selecting indicators is not a lack of measures, but rather the overwhelming number of potentially useful indicators. The International Institute for Sustainable Development selected the following criteria based on indicator literature and practical experience with performance measurement (IISD 2000):

- *Relevance*—Can the indicator be associated with one or several issues around which key policies are formulated? The indicator must be linked to critical decisions and policies.
- *Simplicity*—Can the information be presented in an easily understandable, appealing way to the target audience? Complex issues and calculations should yield clearly presentable and understandable information.
- *Validity*—Is the indicator a true reflection of the facts? Was the data collected using scientifically defensible measurement techniques? Is the indicator verifiable and reproducible? Methodological rigor is needed to make the data credible.
- *Temporality*—Is time-series data available, reflecting the trend of the indicator over time? Several data points are needed to visualize the direction the community or region may be going in the near future.
- *Measurability*—Is the data quantifiable—something that can be measured directly or can be counted? Data must be based on tangible information.
- *Availability and affordability of data*—Is good quality data available at a reasonable cost or is it feasible to initiate a monitoring process that will make it available in the future?
- *Expansiveness*—Is the indicator about a narrow or broad issue? Indicators that aggregate information on broader issues are preferred. For example, forest canopy temperature is a useful indicator of forest health and is preferable to measuring other indicators to come to the same conclusion.
- *Sensitivity*—Can the indicator detect a small change in the system? Determine whether small or large changes are relevant for monitoring.
- *Reliability*—Will you arrive at the same result if you make two or more measurements of the same indicator? Others should reach the same conclusions based on the indicator.

**Table 1. Risk assessment framework.**

<b>Issue 1</b>	<b>Stressor 1.1</b>	Indicator	Data
		Indicator	Data
	<b>Stressor 1.2</b>	Indicator	Data
		Indicator	Data
<b>Issue 2</b>	<b>Stressor 2.1</b>	Indicator	Data
		Indicator	Data

#### **4.1.2 Military Risk Assessment Framework**

The Sustainability, Encroachment, and Room to Maneuver (SERM) Program at CERL is developing an Installation Risk Assessment (IRA) framework that addresses many aspects of installation sustainability, including encroachment. The major risk issues are Air Quality, Land Sustainability, Energy Resources, Water Resources, Social-Economic, and Infrastructure. **Table 1** lists the risk assessment framework, including stressors and indicators.

In addition to CERL indicator development, the Environmental Regulatory Climate Model (ERCM) is underway by the U.S. Army Environmental Center and the Center for Army Analysis (USAEC 2001). ERCM is an indicator-based model used to assess demographic and environmental conditions in support of the Office of the Deputy Chief of Staff for Operations and Plans, (DAMO-TR), Headquarters, Department of the Army, task to analyze the relative training value of a variety of active component Army installations. The umbrella effort is the Installation Training Capacity (ITC) and is used to determine the relative capability of an installations to support live training by Active and Reserve Component units stationed at, or habitually training on, those installations, as well as live training requirements of Service Schools on those installations. ITC focuses on land, ranges, training facilities, and demographic/ environmental factors affecting training. The study did not consider other installation capabilities such as cantonment area facilities, infrastructure, housing, etc. The ERCM is a process to identify and evaluate:

- environmental regulatory issues
- environmental issues that impact training
- encroachment issues that impact training
- impact of costs to maintain land for training
- environmental ability of the land to support and sustain training
- capability of the installation to expand or reconfigure to support training.

The ERCM Methodology is a coordinated effort with USAEC and the major army commands and is continuing to be refined to ensure accuracy of information and

pertinence of the criteria. ECRM is also being combined with CERL's exogenous risk indicator framework to develop a list of environmental factors to consider prior to restationing forces (Tomich 2002). ITC and SERM complement one another and provide independent approaches to similar issues.

The research team is developing a set of risk indicators based on the process, framework and criteria considerations described in Section 4.1.1, above. Since this work is developing indicators that will help determine installation sustainability, our indicators are a combination of issue-based and causal-based. Using a combination framework has the advantage of being able to draw on the strength of the two frameworks while downplaying their weaknesses (Maclaren 1996). This framework will enable a relatively easy assessment of the risk an installation is experiencing and, depending on the risks indicators, appropriate responses will be defined. For risk analyses based solely on issues arising from encroachment, a subset of the risk factors may be used. **Appendix A** includes a proposed Encroachment Risk subset including issue, stressor, indicator, and data framework, based both on the SERM work and ERCM work.

The team also developed an overall prioritization of Army installations based on their mission and facility types. The installations were consolidated into three classes for the purpose of risk assessment priority. The breakouts relate the installation to a perceived risk based on the types of activities on the installation and the potential to move the activities elsewhere. Category I installations are the most critical and difficult to move due to the large land requirements or unique physical plant. Category III installations have the least potential for risk based on environmental issues and (at considerable expense) could be moved. Category II installations fall in the middle. **Appendix B** lists major Army installations broken out by risk category. The categories are defined as follows:

- *Category I*—Maneuver Installations, Major Training Areas, Proving Grounds, and Ammunition Production Plants.
- *Category II*—Depots, Industrial Facilities, Ammunition Storage Facilities, and Arsenals.
- *Category III*—Command and Control and Administrative Installations, Professional Development Sites, Medical Facilities, and RTD&E Centers.

Encroachment issues provide the greatest risk for Category I installations and the set of risk indicators developed was primarily focused on these installations.

#### **4.1.3 Encroachment Risk Indicators**

Encroachment is an issue that is caused by factors originating both inside and outside the installation. For purpose of explaining the data, these are referred to

as endogenous and exogenous factors. Both endogenous and exogenous risk factors can be evaluated in a framework based on installation specific risk issues with a causal-based stressor format. The issues are defined by a set of stressors and indicators define the level of stress. The indicators show where the risks lie and help determine appropriate responses.

#### 4.1.3.1 Exogenous Encroachment Risk Indicators

The selected exogenous stressors are based on community growth outside the installation boundaries and the indicators associated with such growth are determined using national data sources. Five main stressors are: community size, economic strength, DoD impact, community proximity, and water resources. Community size and economic strength indicate pressure for development of land to support residential, commercial, industrial, and support (schools, infrastructure, etc.) uses (Deal et al. 2000). DoD impacts are based on the economic contribution of the installation to the region. An installation that makes insignificant contributions to the region may be more readily regarded as a bad neighbor. Proximity stress results from community growth increasing the contiguity between outside development and the installation. More and nearer neighbors increase the likelihood of incompatibility of landuse and the resulting conflicts. Given sufficient community size and proximity, the installation becomes an unintended growth limiter for the community. Water resources are impacted by regional growth and related consumption and contamination.

Potential indicators for measuring these stressors were selected based on the following requirements:

- available at a uniform scale for the entire study area to ensure consistency in comparisons
- recorded for multiple time periods to enable the evaluation of change
- prepared by a reputable source, such as a government agency or professional data vendor, and accompanied by metadata for quality assurance
- provided in a digital format, to accelerate data gathering and preparation for analysis.

Indicators selected to represent the stressors were population, employment, earnings, developed land, land use classifications, watershed quality, and regional water demand. **Table 2** lists the relationship between the stressors and the selected indicators.

**Table 2. Stressors and indicators for exogenous risk potential.**

<b>Stressor:</b> <b>Indicator:</b>	<b>Community Size</b>	<b>Community Economic Strength</b>	<b>DoD Impact</b>	<b>Community Proximity</b>	<b>Water Resources</b>
Population	Y			Y	
Employment		Y	Y		
Earnings		Y			
Developed land	Y	Y		Y	
Land use classification				Y	
Watershed quality					Y
Water demands					Y

**Table 3. Stressors and indicators for endogenous risk potential.**

<b>Stressor:</b> <b>Indicator:</b>	<b>Emission Status</b>	<b>Natural Resource Context</b>	<b>Cultural Resource Context</b>	<b>External Noise Impact</b>
Non-attainment area	Y			
INRMP		Y	Y	
ESMP		Y	Y	
JBOs		Y		
Training restrictions		Y	Y	
ICRMP			Y	
PLS		Y	Y	
Complaints/lawsuits				Y

#### 4.1.3.2 Endogenous Encroachment Risk Indicators

The endogenous factors assumed to indicate risk are related the type of mission on the installation, the size of its demands for natural resources, the natural history of the installation and its bioregional implications vis-à-vis habitat issues, and indications of effective management. Table 3 lists the relationship between the stressors and the selected indicators. Indicators come from a variety of sources such as the USGS for water resource information, the USEPA for air pollution data and water supply characterization, and the USFWS for endangered species data. The installation itself is the source for much of the data as it relates to management programs and how the installation has historically approached the increasing requirements for natural and cultural resource management.

#### 4.1.4 Encroachment Risk Assessment Examples

To illustrate the approach, three installations are rated under the encroachment risk assessment format. The installations were selected based on an assumed a

*priori* knowledge of their relative levels of risk. The level of risk determined by the assessment process should validate our pre-conceived ideas that Forts Carson, Benning, and Riley range from high risk to low risk. The raw indicators and the risk scores of the assessment are shown in [Table 4](#).

The results are not definitive because of a lack of current data for all indicators, but certainly show the potential of the methodology and indicate trends. The results were also somewhat counter-intuitive in that Fort Benning showed nearly the same risk as Fort Carson. Fort Riley showed the lowest. The specific causes for Forts Benning and Carson's high-risk profile differed, but the results were the same. Fort Carson's major risk factors came from its close proximity to a major high growth, metropolitan area, Colorado Springs, while Fort Benning's risks came from a large amount of medium level risks from being in a rapidly growing state and region, having endangered species issues, and pending water issues. Fort Riley's major risk issue is associated with water contamination in the region and watershed issues. It should be noted that many of these individual indicators could, by themselves, highlight an installation at risk for one or more encroachment issues. The composite score indicates how broad the range of risk issues is and points to areas of concern. The goal of the assessment is to determine where emphasis should be placed without any knowledge of current risk—where are the future problems? The assessment indicates that almost any installation is at risk for some encroachment issue and that management needs to proactively be aware of these potentials and seek mitigation activities.

## 4.2 Understand Options for Encroachment Mitigation

Evaluations of installations at risk from encroachment related issues determine the required course of action. The characterization process, above, results in a list of installations that may soon be experiencing or already are experiencing impacts on mission and readiness due to outside forces in the region. Based on the characterization and any known encroachment issues for the installation, a decision on how to proceed is required. An installation facing encroachment risk has essentially five courses of action:

1. Do nothing.
2. Change land uses on post when unavoidable.
3. Engage in regional planning.
4. Actively manage and change land uses on post.
5. Actively manage and change land uses off post.

Table 4. Encroachment risk assessment.

Issue	Stressors	Indicators	Fort Carson		Fort Benning		Fort Riley	
			Indicator	Risk	Indicator	Risk	Indicator	Risk
<b>Air Quality</b>	<i>Emission Status</i>	Non-attainment area	N	0	N	0	N	0
<b>Urban Development</b>	<i>Community Size</i>	Regional Population Density	313	4	149	2	43	0
		State Degree of Population Urbanization	84%	0	69%	2	56%	2
		State Degree MSA Land	18%	0	22%	2	7%	0
		Degree of Regional Land Urbanization	5.6%	4	2.1%	2	1.1%	0
	<i>Community Economic Strength</i>	Regional Population Growth	20.8%	4	4.4%	2	-17%	0
		Earnings Per Capita Growth	40%	4	37%	4	34%	2
		Increasing Regional Population Growth Rate	Y	2	Y	2	N	0
		Urban Development Growth	19%	0	57%	4	11%	0
<i>Community Proximity</i>	Contiguous Large Metro	500k	4	272k	2	65k	0	
<b>Social and Economic</b>	<i>DoD Impact</i>	Military Employment Change	-5172	2	-4590	2	-6960	2
		Military Employment Ratio	9.41%	2	20.6%	0	40.55%	0
		Gov't Employee Density	0.18	0	0.11	0	0.10	0
<b>Natural and Cultural Resources</b>	<i>Natural Resource Context</i>	Integrated Natural Resources Management Plan (INRMP)	Y	0	Y	0	Y	0
		Endangered Species Management Plan (ESMP)	N	0	Y	4	N	0
		Jeopardy Biological Opinions	N	0	N	0	N	0
		Training Restrictions (internal)	Y	4	N	0	N	0
		Regional T&E Issues	Y	4	Y	4	Y	2
	<i>Cultural Resource Context</i>	Integrated Cultural Resources Management Plan (ICRMP)	Y	0	N	2	N	2
		Planning Level Surveys	Y	0	Y	0	Y	0
<b>Water</b>	<i>Watershed Withdrawals</i>	Regional Water Fresh Water Consumption Growth	19%	2	38%	4	-4%	0
		Regional Ground Water Fraction of Total	13%	2	10%	0	28%	4
		Domestic Water Fraction of Total Withdrawals	7%	4	26%	2	42%	0
	<i>Watershed Health</i>	Index of Watershed Indicators	1	0	3	2	5	4
		Impaired Waters	N	0	Y	2	Y	2
<b>Noise</b>	<i>External Noise Impact</i>	Noise Impact Factor	1.5	4	5	0	1.5	4
		RISK TOTAL		46		44		24

Option 1, “Maintaining the status quo by doing nothing,” is what most installations have been doing. With the introduction of an objective risk assessment, this approach includes continued monitoring of the installation and updating the assessment tool as new information is made available. Temporal changes in indicators will provide a measure of how the situation is evolving and eventually, identifying when “no action” is no longer viable.

Option 2 results from reacting to unavoidable external pressures—from ESA compliance, local community, private landowner lawsuits, etc. Examples of this are Fort Sill (moving the small arms range), Fort Carson (shifting large training activities to Piñon Canyon), and Fort Bragg (the training land restrictions for RCW protection). Option 2 results from installations following Option 1 for too long creating a confrontational situation with immediate calls for action where responses are reactive, result from poor negotiating positions, and have limited alternatives for resolution.

Option 3 is gaining favor, but involves long-term efforts in regional planning that rely on external jurisdictions for enabling real change on the ground. They are valuable for building connections with neighbors, exposing positive Army efforts to the public, establishing zoning to ensure military compatible land uses, and awakening local area responsibility for ecosystem and T&E sustainability.

Option 4 should be implemented at all installations, not just at those found to be at high risk. This would involve assessment of on-post activities for how they reach beyond the fence line and maximizing effective use of existing lands and ensuring long-term sustainability. This is accomplished by characterizing installation land, understanding how that land meets its current mission, and predicting what might be needed in the future. Much of the underlying information exists along with the evaluation tools. The management approach is part of standard requirements and policy for installations.

Option 5 is about controlling landuse actions outside the fence with conservation partnerships on private lands. It offers the potential for short-term, concrete action to mitigate severe on-post issues while the longer-term efforts are being negotiated. This is still an opportunistic approach—it relies on the existence of willing sellers with “useful” land. It is only possible if leveraged by partners with complimentary land interests who can work cooperatively to find and manage properties to multiple objectives. It should not be assumed that pursuing this option will de facto be beneficial; success depends on sufficient understanding of the issues to enable identification of suitable land for acquisition and that land is available at affordable prices.

The best encroachment mitigation strategy is a combination of Options 3, 4, and 5. These efforts can be guided and their success measured through risk assessment and regional modeling.

### **4.3 Establish a Collaborative GIS for Mitigation Planning**

Any action taken to assist in encroachment mitigation would benefit from the use of geographic information systems (GIS) as decision support tools. A GIS is a specialized software product that permits the capture, maintenance, retrieval, integration, visualization, and analysis of spatially explicit information. Incorporation of GIS is becoming a recognized component of any landscape relevant planning exercise, from the site to the global scale. At a minimum GIS can help capture and report the current state of the landscape under examination. With more resources and time, the exercise can include development of unique data, examination of process models, and application of analysis techniques to depict historic patterns, predict future scenarios, or explore alternative strategies.

Most large installations have GIS capabilities, and have been collecting and developing data for many years. Historically the installation's approach to capturing data for GIS use has been to focus only on the landscape inside the fence line, as a way to reduce the costly expenses of developing and maintaining data. This limitation is not unique; government jurisdictions are likely to have pursued the same approach and halted their data collection or development efforts at their "fence lines" (if they have actually begun to establish GIS capabilities). Any regional or cross-jurisdictional examinations for encroachment mitigation opportunities will require the assemblage of GIS data that was developed and managed under different conditions, for different purposes, with differing degrees of quality control. Collecting and integrating this data will be a time-consuming process that will likely require data manipulation to correct conflicts or additional data development to fill gaps. But all encroachment planning options can benefit from an integrated database, so there would be long-term leveraging of the expense of developing spatial data if GIS was undertaken with a collaborative, multi-purpose intent.

A good example of a shared GIS data resource is the San Pedro Geodata Browser (Kepner et al. 2000). The San Pedro River Basin became a focus for environmental research and monitoring in 1995, as urban development and other human-induced changes were seen to have critical impact on water resources, biodiversity, and endangered species habitats. Numerous government, research, and conservation organizations have contributed to the regional research and planning activities. The USEPA took the lead in developing an integrated geo-

spatial database to serve as a launch point for evaluating landscape change and to encourage community groups to understand their impacts in the broader regional concerns. Data was collected from many sources, including Arizona State Land Department, U.S. Department of the Interior (Bureau of Land Management and U.S. Geological Survey), and the U.S. Environmental Protection Agency. These various products were reformatted, organized, fully described with metadata and made accessible on CD-ROM and through the Internet at URL:

[www.epa.gov/esd/land-sci/html2/pages/sanpedro\\_geodata2.html](http://www.epa.gov/esd/land-sci/html2/pages/sanpedro_geodata2.html)

#### **4.4 Model Regional Landuse Change and Urban Dynamics**

The Military Landuse Evolution and Impact Assessment Model (mLEAM) is a spatially-dynamic decision support (SDSS) system to simulate the growth patterns of a military installation and the surrounding urban community. The model uses the Spatial Modeling Environment (SME) collaborative environment adapted for the purpose of developing a SDSS to evaluate human development patterns (Deal and Fournier 2000). The value of mLEAM is in helping evaluate, communicate, and explore what the future will look like based on policy choices, mitigation actions, and landuse change drivers, and evaluating their impact on regional sustainability. Dynamic interactions between the military installation, the urban system, and the surrounding landscape are captured with model drivers. Scenario maps visually represent the resulting land use changes. Altering input parameters (policies) changes the spatial outcome of the scenario being studied. This enables what-if planning scenarios that can be visually examined and interpreted for each simulation. Scenarios are also evaluated according to a series of sustainability indices that provide quantified measures for relative impact measurements.

##### **4.4.1 mLEAM Model Development**

The initial model was developed at the University of Illinois with funding from the National Science Foundation, and describes land-use changes across a landscape that result from the spatial and dynamic interaction among economic, ecological, and social systems in the region. In the mLEAM approach, groups or individuals who have substantive knowledge relating to a particular system develop and test separate models of that system. These contextual sub-models are run simultaneously in each grid cell of raster based GIS database and are linked to form the main framework of the dynamic spatial model (mLEAM). The SME collaborative approach enables the model to be created in an open and distributed manner that brings different expertise to bear on the problem.

tributed manner that brings different expertise to bear on the problem. Inputs to the model are landuse data, census data, and economic data (readily available and transportable to multiple sites), along with variables relating to impact assessment sub-models (e.g. habitat, ecoregion, water, and energy) to parameterize the model. The products of mLEAM model runs of a series of policy scenarios are GIS maps or movies that show the transformation of the subject landscape. These dynamic visual outputs are critical for testing policy scenarios and raising concerns regarding the impacts of development, environmental degradation, or conflicting land-use policies (George 1997). mLEAM includes a simple user interface with transportable models for application to multiple sites.

Figure 2 shows the fundamental mLEAM approach to capturing land use transformation dynamics. It begins with model drivers. Model drivers are considered those forces (typically human) that contribute to urban land use transformation decisions. The model drivers describe land use transformation probabilities. The simulation visually displays the landscape transformation realized at each time-step using scenario based planning exercises. The resulting visual images are then analyzed for environmental impacts during the impact assessment phase. Sustainable indices based on the derived impacts are then developed to feed back into the model drivers.

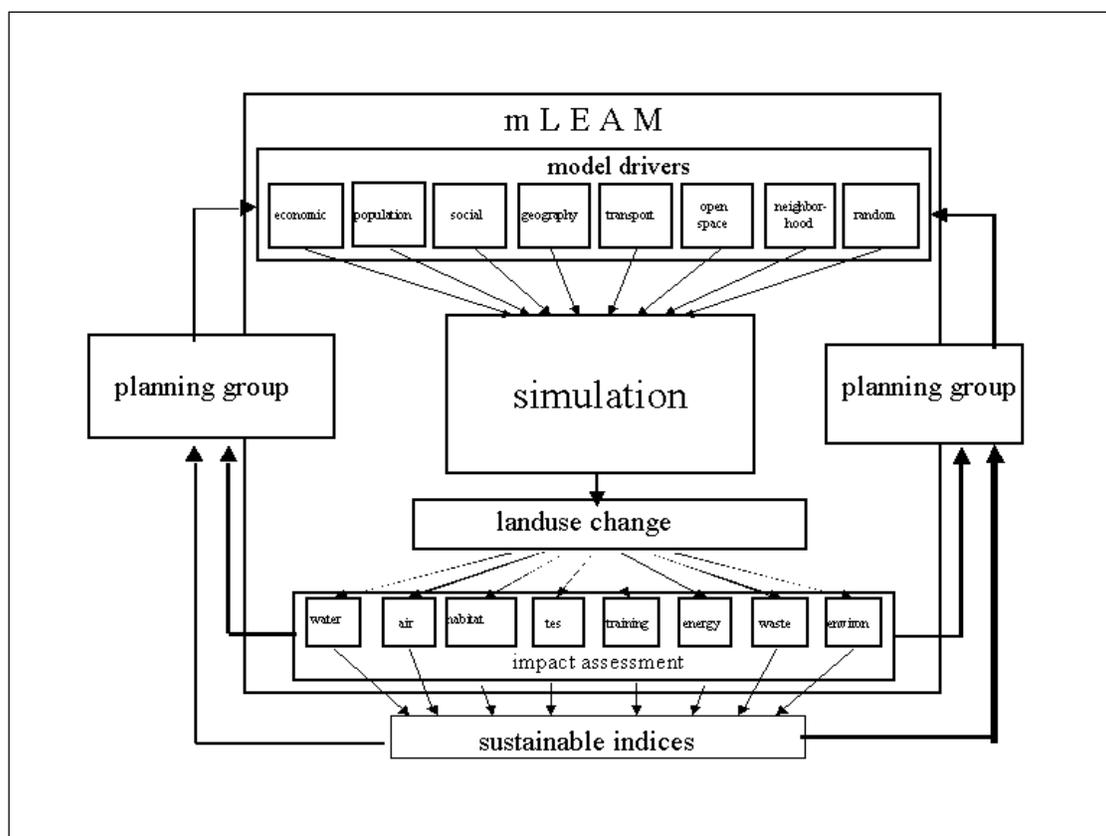


Figure 2. The mLEAM spatial modeling environment.

The mLEAM model uses a 30m x 30m raster based land use map, based on the USGS National Land use Classification System. The initial maps are used to parameterize the existing land use conditions (the model uses a 30 x 30 meter resolution to simulate the parcel by parcel decision making that influences urban growth patterns). The existing land use is then analyzed for its development probability at each time step. The probability of a cell changing to an alternate land use depends on how the conditions for change in the immediate (as well as global) area of study have changed using a current state/previous state approach.

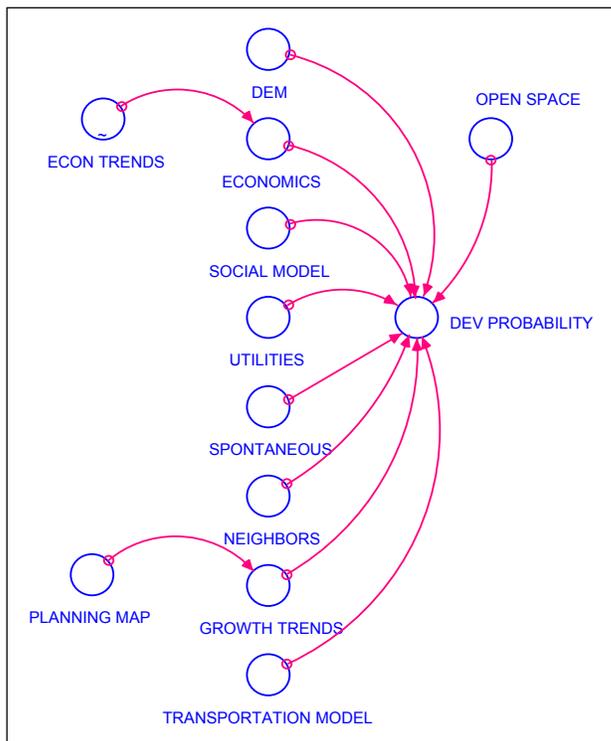
A current state/previous state probability chain describes the behavior of transition probabilities between a system's states. The process considers the different states that any particular cell in the modeled landscape can assume and the statistical probabilities that govern the transition of the phenomenon from one state to another. In the mLEAM approach, any developable cell in the landscape has a probability of land use change associated with it. The calculation of the cell's probability is based on a set of criteria that is evaluated by the model at each time step. Each variable considered in the chain affects the overall development probability (DPR) of land use change.

$$\text{DPR} = \text{LUex} (f \text{ Ut} + \text{Nr} + \text{Ec} + \text{Pp} + \text{So} + \text{Oc} + \text{Rr} + \text{Rs} + \text{Dm} + \text{Gt} + \text{Tr}...) \quad \text{Eq 1}$$

where:

- LUex determines the existing land use condition.
- Ut defines utilities and resources available at the site.
- Nr describes the neighboring land use characteristics.
- Ec represents the local economic conditions.
- Pp represents the gross population projections.
- So represents social decision making factors.
- Oc describes the probability that the cell will develop as open space.
- Rr determines the presence of roads.
- Rs defines the random chance of land use change (spontaneous growth).
- Gt describes the spatial growth trends of the region.
- Dm describes the geography of the area.
- Tr represents traffic congestion coefficients.

Each driver is developed as a sub-model; definitions are completed and run independent of the larger mLEAM organization, see [Figure 3](#). Variables of interest can be scaled and plotted in formats that help visualize sub-model behavior and contextual experts can calibrate and test sub-model behavior before it becomes integrated into the larger model. Using iconographic modeling techniques for sub-model development greatly decreases the learning curve for enabling contextual experts; it also increases the ease with which the model can be changed and calibrated. The effects of changes made can be viewed immediately, allowing the user to concentrate on modeling instead of computational details.



**Figure 3. mLEAM model drivers.**

Many spatially-explicit tools exist to identify probable patterns of development. These other models generally lacking drivers that contribute to land use change and the identification of the impacts that these may produce. The identification of these impacts is an important component of the mLEAM modeling system.

#### **4.4.2 Using mLEAM for Encroachment Mitigation Analysis**

Many exogenous stressors result from urban development and land use change pressures in the region of the installation. Modeling these changes and the expected indicators that would result from the change scenario provides a future picture of risk for the installation. This decision support environment provides a means of dynamically seeing the results of policy decisions such as zoning and buffers and also mitigating actions such as habitat preservation and conservation actions.

### **4.5 Support Regional Cooperative Efforts**

Historically, Army installations did not have a significant impact on neighboring communities until development and population pressures placed the surrounding communities in closer proximity to military operations. The Army installa-

tion still may be the major urban center in the region and the economic driver for much of the development outside of its boundaries. Enlightened self-interest requires that the installation become a participant in and promoter of regional planning activities and growth management processes within its area of influence. Encroachment issues are increasing and a proactive stance is far better than sitting idly by while uncontrolled growth becomes a problem.

#### **4.5.1 Conservation Research Partnerships**

Conservation research partnerships have historically been used to assist installations in developing their natural resource program. As shown in the examples in Section 3, partnerships can be an effective approach to addressing not only issues on the installation, but in developing a regional approach to encroachment mitigation. The cooperative agreement approach using conservation research partnerships is a good starting point and fosters this regional approach. Scientific baseline information and knowledge allows for more effective decisions and expands the capabilities of an installation to effectively address regional natural resource issues. Experiences in both the Army and other services have shown that a cooperative, regional approach to natural resource issues can have significant positive impact (McCall 2001).

#### **4.5.2 Regional Planning**

A successful approach to managing exogenous urban growth is the JLUS program within the Office of the Secretary of Defense (OSD). This community and economic development program provides resources to communities, who, in conjunction with neighboring military installations, agree to undertake joint regional planning. Resources are provided by the Department of Defense for attaining planning expertise with a desired result of a joint land use plan that provides optimal zoning recommendations to reduce civil-military friction resulting from urban growth. Success of this approach is dependent on both the installation and the local communities being willing to follow through on recommendations and take specific actions in a regional planning context to alter development patterns and address the specific issues of encroachment affecting that installation or region. The JLUS process presents opportunities that an increasing number of Army installations should be investigating and using. The joint study program requires efforts from both the surrounding community and the installation, but allows the installation to bring something to the table that was not there previously.

### **4.5.3 Social Marketing Research, Education, and Outreach**

Installations that pursue mitigation with off post actions may encounter resistance and suspicion from the local communities. One way to reduce these conflicts and help ensure the success of the actions is by involving people in the decisions that affect them. This effort can be facilitated with social marketing research tools that capture constituent groups' knowledge, attitudes, concerns, interests, and behaviors. A local firm or academic institution could be contracted to conduct telephone surveys, interviews, focus group discussions, or other techniques to generate qualitative and quantitative information useful in designing outreach and education campaigns. The process can yield information on current knowledge levels about environmental or urbanization issues, attitudes towards the installation, local community priorities for conservation or development, and interest levels in becoming involved in conservation and recreation activities.

The social knowledge gained through attitudes research will be valuable in guiding an effective education and outreach program to support the mitigation activities. Education should focus not just on communicating the military's concerns to the public (how regional landscape changes negatively impact military readiness), but also communicating the military's recognition of communities' concerns and interests and how the military can and is contributing to the region's natural resource enrichment. Outreach efforts to gather local support include involving local agencies in decisionmaking and prioritization, identifying and emphasizing common concerns, and expanding the uses of acquired lands to accommodate local interests. Consistent efforts to maintain communications and share information will serve to develop trust, and reduce potential conflicts about military intrusion into local jurisdiction concerns.

### **4.5.4 Identify Partners**

The resolution of the multifaceted issues of encroachment and land use conflicts across co-mingled public and private landscapes requires participation of a variety of interested and diverse stakeholders. There are many potential partners at all levels of government and within the non-profit sector. **Appendix C** provides a list of organizations who may be potential partners or allies through either their interest in landuse issues or conservation. It is important to reach out to partners beyond TNC and the USFWS. State entities, such as departments of transportation, may also be viable partners for cooperative agreements. They bring additional resources and have complementary goals that can strengthen the overall effort. Fort Riley has an agreement with Ducks Unlimited and Fort Hood with the local Central Texas Cattlemen's Association along with Texas state

agencies. Fort Huachuca has partnered with the Bureau of Land Management and the Upper San Pedro Partnership. TNC can be the partner who helps pull it all together, finds other partners and forms centers and associations.

## **4.6 Assess Private Lands for Acquisition**

If private land acquisition appears to be a viable and beneficial option, embarking on land evaluation through suitability assessment will help direct and prioritize this effort. The term land acquisition refers to either fee simple or easement purchase from willing sellers.

### **4.6.1 Overview of Land Suitability Assessment**

The process of identifying land best suited for a targeted use is generally labeled land suitability assessment. This is a process that, either formally or informally, evaluates areas based on one or several criteria that indicate appropriateness for land uses. The technique is similar to the use of indicators in risk assessment, with the additional requirement of understanding how an indicator varies over the landscape. Suitability assessment involves:

- selecting factors that describe the landscape according to land use needs
- assigning values to the range of characteristics for a factor to indicate a relative importance of the characteristic to the assessment (For example, certain soil types are more favorable to building on than other soil types and would be valued higher in a building suitability assessment.)
- determining how those factors are distributed across a landscape
- accumulating multiple factor/value combinations using some reasonable and consistent method to summarize the criteria and allow comparison across areas.

The identification of this as a formal process can be attributed to Ian McHarg, whose map overlay technique promoted environmentally and socially compatible development choices (McHarg 1969). It has been implemented, evaluated, and enhanced regularly since then, especially as the growth of GIS enabled broadening of the exercise both in terms of spatial explicitness and technical complexity. A review of published literature and the numerous methods for deriving a suitability assessment score seems unnecessary. A general observation on the variety of methods is that the more factors that are thought to be necessary to the decision, the more complex the model becomes. The most complex models seek to determine the maximum allocation of a variety of land uses spread across a diverse landscape to satisfy multiple social objectives. But in clearly defined

situations, adding too many factors to the equation may only dilute the value of the significant factors, rather than add knowledge to the model.

#### **4.6.2 Criteria for Acquisition Suitability Assessment**

The following criteria were used to guide the development of the recommended acquisition suitability assessment approach:

- flexible enough to address an installation's specific encroachment issues
- simple, practical, and produces results that are easy to interpret by all acquisition partners
- focused on the goal of acquisition: the most significant components are land characteristics, land value, and land availability
- feasible in a short timeframe
- expandable over time as data and knowledge improve.

To assist in issues of timeliness, some concepts were borrowed from the Rapid Ecological Assessment (REA) approach developed by The Nature Conservancy (Sayre, Roca et al. 2000). The primary focus of this approach is techniques and tools for vegetation characterization and biodiversity inventorying for areas where existing biotic information is poor. The goal is to build a basic (intentionally non-exhaustive) baseline of biological assets and a preliminary, integrated, and spatially explicit database that is still scientifically viable for conservation planning. The details of the ecological assessment may be valuable to installation planning actions if data development is needed for environmental mitigation issues. But the aspects of REA that are most important to acquisition assessment are the techniques to ensure rapid development: the use of spatial technologies, goal setting and adherence, establishing an appropriate standard for data selection that balances quality of representation and timeliness, and reliance on experts and local resources to speed data gathering and evaluation.

#### **4.6.3 Suggested Approach**

The suggested approach to suitability assessment in the context of military encroachment mitigation is a very focused, simple model that describes general land capabilities, values, and availability to meet well-defined goals in a rapid manner. This should result in an assessment that is practical, sufficient to the requirements, and responsive to encroachment issues. The basic paradigm for acquisition suitability assessment is:

- formalize goals for acquisition properties
- identify landscape characteristics relevant to goals
- create a GIS-based assessment database

- evaluate, delineate, and rank suitable lands
- explore acquisition potential.

Details for these processes are provided in the remaining sections of this chapter. The assessment process should be initiated quickly within a well-defined time-frame, with the objective of determining feasibility as much as furthering the goal of immediate improvements in the encroachment issue. It should not be considered complete, however. The assessment should continue to evolve in an iterative approach, with updates to landscape capability data to reflect the availability of new and better information over time.

#### **4.6.4 Formalize Goals for Acquisition Properties**

The framework for acquisition evaluations should be based on clearly articulated objectives to be satisfied by each prospective property. Goal identification is one of the key components for success by participants in the private lands acquisition efforts (Belfit 2002). For example, Fort Bragg has established four criteria to consider when evaluating a property for acquisition:

- Does it now or can it be managed to support RCW? This criteria aims to fulfill the Army's responsibility for target species recovery and reduce land use restrictions on post.
- Does it now or can it be managed to protect other significant and related ecosystem resources? This is a proactive goal to limit future land use restrictions by preventing additional ESA targets.
- Does it provide additional maneuver space for "light" training that is compatible with other goals? This captures consideration of Fort Bragg's identified training lands shortfall, but only within the context of meeting other needs.
- Can it protect against future land use incompatibilities? This is a second proactive goal that would enable the installation to ensure that adjacent lands retained uses that were compatible with military activities and avoid future urbanization encroachment.

The Fort Bragg goals present a good range of issues that can be addressed with off post property or easement acquisitions. Obviously these will vary for each installation, at a minimum to reflect the local encroachment issues and perhaps to discount training or urbanization needs.

Once established, the goals should be central to all activities related to off post mitigation, providing the framework for evaluating success from the negotiation of agreements with conservation partners through the approval of individual

land purchases. Still, there should be room for compromise on these goals especially at the site selection scale. A target property that satisfies all objectives may be rare; properties that satisfy two or three objectives may still be very valuable to acquire. While acquisition is primarily a short-term action strategy, it should also reflect a longer-term perspective where individual property acquisitions are managed collectively over time to combine to achieve all the goals.

#### 4.6.5 Identify Relevant Landscape Characteristics

The second step is to translate the stated goals into physical landscape characteristics that would fulfill them. These characteristics will likely differ for each goal. For example, to support habitat for a particular endangered species, desirable landscape characteristics would include existing or potential vegetation types. In brainstorming about characteristics, it is important to identify both optimal information and proxy information—data that might predict a potentially suitable area if optimal information is unavailable. Using the Fort Bragg goals for RCW support, the example for an optimal data set would be a vegetation classification that could distinguish long-leaf pine of a certain age and canopy density, while a more realistic proxy set would be soil types in which long-leaf pine can thrive. [Table 5](#) lists additional examples.

**Table 5. Examples of goal-specific landscape characterization.**

Goal / Land Use Need	Characteristic	Proxy
Endangered species recovery	Preferred habitat, locations of known occurrences	General habitats, elevation, soils, climate/precipitation, geology, hydrology
Ecosystem protection	Other target species preferred habitat or critical vegetation types / landscape zones, and known occurrences	Data similar to ES Recovery, overlaid to identify target ecosystem vegetation / landscape type characteristics
Urbanization buffer	Installation border lands with high probability of development incompatibility	Undeveloped lands, off-post noise/dust/air disturbance zones, development direction trend
Wheeled vehicle training	Indicators of road and trail surface materials, stream crossing capability and vulnerability, connectivity to installation network	Road network, hydrology network and biological quality, soils, elevation
Air access training	Vegetation clearings, level terrain, air accessibility	Vegetation types, air traffic corridors, air traffic restrictions
Off-vehicle training	Indicators of terrain variability, vegetation density, visibility	Vegetation types, elevation

The most efficient method for defining the landscape characteristics of interest is in consultation with an appropriate land use expert. Natural resource managers will be best able to describe critical endangered species and ecosystem characteristics, while training land managers will be the best resource for describing training land requirements.

#### **4.6.6 Create a GIS-based Assessment Database**

##### **4.6.6.1 Define the Geographic Area of Interest**

GIS database development begins with the definition of a geographic area of interest. For these assessments, the area should be a maximum possible range for acquisition consideration. It is defined by recognizing there is a diminishing return on investment over space—some distance beyond which, regardless of characteristics, properties are too remote from the installation to meet the acquisition goals. The definition of the area of interest may vary for each goal, so the initial delineation should be generous. At a minimum it should include a uniform buffer zone, whose width might be based on noise, sound, or dust contours emanating from the installation. To address biological issues, it might include consideration of watersheds, ecoregions, aquifers, stream networks, riparian zones, migration routes, and the locations of existing managed conservation areas. To capture potential sources of urbanization pressures, it might also consider transportation networks and connections to metropolitan areas.

##### **4.6.6.2 Review Existing Data Sources**

Data gathering should begin with a survey of existing data sources. The survey should result in an inventory that organizes data by general information types (administrative, natural features, significant resources, demographics, land use, raw data such as imagery) and gathers all available metadata. If a cooperative GIS has already been established, this process becomes easier. If not, the search should begin with the installation's GIS, assess general data sources such as USGS, USDA, and state departments of natural resources, and explore all local jurisdictions for planning and property ownership information. The inventory should allow data sets to be compared in terms of how well they cover the area of interest, their scale and accuracy, and their ability to help characterize the landscape according to acquisition needs. Developing the inventory up front will focus later efforts in database development. It will prevent collection of redundant or inappropriate data and minimize data conversion tasks. And it will help guide and prioritize data development for critical (but unavailable) information.

#### 4.6.6.3 Collect Regional Landscape Data

Once an inventory is in place, basic descriptive data about the area can be quickly collected. This is data that will provide both visual and physical context for the assessment. Typical descriptive data should include: jurisdiction boundaries (municipal, county, and state boundaries as appropriate); transportation systems (roads, railroads, airports); hydrology (lakes, streams); major public or conservation land holdings (other installations, Federal, state or county parks, Bureau of Indian Affairs (BIA) holdings, private conservation holdings). Selection of data should be driven by the inventory, and should consider what data provides the most complete coverage for the study extent with the least amount of processing.

A more time-consuming step will be the collection of data to represent the landscape characteristics. It is unlikely that the ideal characterization exists for any of the targeted land uses. The proxy data will have to be collected, evaluated, and probably transformed in some way (using reclassification, buffering, overlay, or other analysis techniques) to appropriately represent land use characteristics. Rapid processing is facilitated by having a technical resource first collect all the GIS data identified as potential proxies for each land use, and then work with local functional experts (biologist, forester, trainer) to derive suitable characterizations. Data selection should balance processing time against value to the assessment. For example, if a dataset provides a key component in landscape characterization, then its costs and conversion requirements are worth its detail and accuracy. However, if a dataset is only marginally relevant, only minimal effort should be devoted to its acquisition.

**Table 6** lists GIS-ready data sets that should be available for most installation regions and extents in the continental United States. Availability will vary even for data produced under the direction of centralized sources such as the USGS.

#### 4.6.6.4 Collect Local Government Planning Data

Local government planning data could provide useful information on regulatory restrictions and future planning goals that might present opportunities or barriers to acquisitions. The acquisition database should contain the boundaries of all local government or taxing bodies that might be impacted by the transference of private land to a conservation (and potentially non- or lower-tax) status. Examples include county, municipal, and township boundaries, school and other service districts, and other special taxation units. Another type of useful information is any current and future land use zoning, and the relevant regulatory restrictions applied to the different use classes.

Table 6. GIS-ready data sets.

Data Type	Source	Description
Land Use	USGS NLCD ( <a href="http://landcover.usgs.gov/natl/landcover.html">http://landcover.usgs.gov/natl/landcover.html</a> )	30m resolution, circa 1992 conditions; 21 category land cover. Good basic land use data set, consistent interpretation for entire CONUS. Data available by state for most states.
Soils – STATSGO	USDA – NRCS * ( <a href="http://www.ftw.nrcs.usda.gov/stat_data.html">http://www.ftw.nrcs.usda.gov/stat_data.html</a> )	1:250,000 scale statewide general soil maps with supporting component & attribute information. Data available by state for all states.
Soils – SSURGO	USDA – NRCS * ( <a href="http://www.ftw.nrcs.usda.gov/ssur_data.html">http://www.ftw.nrcs.usda.gov/ssur_data.html</a> )	Variable scale (1:12,000 to 1:63,360) countywide detailed soil maps with supporting component and attribute information. Data selectively available by county.
Detailed Land Cover	USGS – GAP ( <a href="http://www.gap.uidaho.edu">http://www.gap.uidaho.edu</a> )	Minimum of 1:100,000 scale statewide data with particular emphasis on vegetation for biodiversity analysis. Though managed under the USGS umbrella approaches, products and availability vary by state.
Land Stewardship	USGS – GAP ( <a href="http://www.gap.uidaho.edu">http://www.gap.uidaho.edu</a> )	Variable scale statewide data of public and private lands managed for biodiversity conservation. A more uniform product than the related land cover, but availability varies by state.
Elevation	USGS – delivery through the GeoCommunity ** ( <a href="http://www.gisdatadepot.com">http://www.gisdatadepot.com</a> )	Variable scale and extent raster products depicting elevation (can be transformed to slope and aspect). Choose the largest scale product available (preferably 1:24000).
<p>* The attribute database for both soils data sets are complex. Also, SSURGO soil map units vary by county, so joining data for a region can be complicated. Look for local or state sources that have already transformed the data, or expert guidance on soil properties to expedite use.</p> <p>** This data is delivered in typical USGS mapping extents of quadrangles or minute zones. Different scale products will be delivered at different extents. Retrieval from the referenced website requires knowledge of the names of the relevant mapping extents, which can be difficult to discover. Also, combining multiple elevation files can be complicated. Look for local or state sources that have already transformed the data.</p>		

Finally, also informative would be any other miscellaneous regulatory zones, such as restricted floodplains or other designated restricted environmental zones, Native American cultural sites, and special use or planning districts.

Acquisition studies are likely to extend over multiple local government jurisdictions. Unless a cooperative GIS has been established, it is unlikely that desirable government planning data will already exist in GIS or any digital format, or that the jurisdiction would have similar approaches to its development, physical format, and public access. The ability to collect and integrate this data will depend on strong local contacts, coordination of efforts, and reciprocity of data access

#### 4.6.6.5 Collect Private Property Ownership Data

Property ownership data consists of two components, the physical location and extent information (the parcel map) and the attribute information (characteristics tracked for the tax assessment process). While any spatial data can be expensive to develop, property data is thought to be the most costly layer to build for local governments (Korte 1997). A late 1980s review of GIS property data development found cost estimates ranging from \$21 to \$30 per parcel (Public Technology et al. 1991). The costs and complexities of development and maintenance explain why this data suffers from limited availability in any digital format. This is especially true in the less-populated towns, cities, and counties where military installations are often located.

Regardless of the current format of the data, efforts at incorporating property ownership will likely involve the same issues for integration across multiple jurisdictions that apply to other planning data (Moudon and Hubner 2000). And there are likely to be more logistical issues when efforts to obtain property data are made by an outside organization. While all the information is technically public, the county agencies are often reluctant to release wholesale collections of property maps (either digital or paper) or attribute data. Each jurisdiction may have different methods of providing public access to the data, including policies that limit retrieval to specific property enquiries.

The high costs of developing digital property ownership data are mostly the result of staffing resource needs. Capturing the location and extent information usually requires manual digitizing from paper maps and / or interpretation of written survey records. While paper maps are easier to translate, these are often produced under contract by a private company and will need updating (per survey descriptions) for property subdivisions that have occurred since the last printing. The size of the maps will vary by producer and many sheets will be needed to represent the entire county. Larger sheets will be harder to scan, but easier to digitize. Depending on resources and expected uses of the data, translation of these maps into a digital form suitable for GIS might include: scanning, tablet digitizing, georeferencing (defining the data in terms a specific geographic coordinate system and location on the earth), on-screen digitizing, area representation (identifying the boundaries of property units), and annotation (labeling each property with its unique identifier, preferably the property identifier used for tax assessment).

The acquisition study realistically does not need complete ownership information for the entire geographic area of interest. Before proceeding with any digital conversion tasks, the study participants should examine the large region and

identify zones for exclusion and zones of significant interest. Zones for exclusion are any areas that are already significantly developed or subdivided. Properties in these areas will be too expensive to either acquire or restore for conservation purposes. A first estimate of these zones can be determined from either land cover or government land use data. The subdivided (but as yet undeveloped) areas could be visually interpreted from the paper property ownership maps and roughly captured for the GIS based on boundaries defined by the road network. Zones of significant interest are any areas outside the exclusion areas that, based on the landscape characteristics data, appear to offer strong potential as conservation properties. To ensure rapid assessment and best judgments, local resources with good knowledge of the existing real estate situation should be called on for assistance. Conservation partners such as TNC will likely have in-house resources or outside contacts with local property expertise. The resulting selected areas become the test for establishing relationships with the tax assessors for access to the data and for developing procedures to digitally capture the location and extent information. Because the data is not serving as a legal property boundary definition, but only as an aid in an acquisition potential assessment, data development procedures do not need to ensure the high degree of accuracy that might be desirable for local government use.

As an alternative to custom data development, the study participants should examine pursuing large-scale digital capture of the property location and extent information as a cooperative GIS experiment. Sharing of costs across multiple agencies would enable a wider scope of work than could be funded by the agencies independently. Agencies could contribute resources in different ways: hardware and software, personnel, direct funding or pursuit of grants. Getting participation from an academic institution with a GIS facility could be valuable in terms of both accessing skilled resources and gaining additional expertise for future collaborative exercises. The focused effort would provide a trial environment for establishing data development and documentation standards, enabling public accessibility, and fostering working relationships among the region's agencies.

#### **4.6.7 Delineate and Rank Suitable Lands**

Once the GIS data has been collected and transformed to characterize the landscape within the area of investigation, study participants need to evaluate the relative desirability of all potentially available land areas. For rapid acquisition assessments a simple weighting and rating scheme should be suitable. This approach produces a summary score for different land areas that expresses the relative value of an area in meeting the expressed acquisition goals. The formula is generally represented as:

$$\text{score (LU, area)} = \sum (W * R)$$

Eq 2

where:

- LU = the targeted land use
- area = the parcel or homogenous area being scored
- W and R = the weight and rate applicable to a particular land characteristic that is significant to the LU.

The linear formula is easy to implement; it is the determination of the values for W and R that are complicated, and typically based on subjective evaluation. This task is best accomplished with the advice of appropriate experts regarding the land use and characteristics being evaluated.

First each landscape characteristic relevant to the land use goal (discussed in 4.6.5) is classified and scaled or rated. For example, soil type might be a relevant characteristic for determining the potential to restore an endangered species habitat. The soil types would be classified based on some known characteristic (soil composition, typical vegetation association, etc.) then rated based on their ability to support the habitat. It is better to use a rating system (for example, a scale of excellent, very good, good, fair, poor) with a high value assigned to the best classification and a low value to the worst. This is preferred over a ranking system (unique ordering of each classification in a relative scale from 1 to n) as long as there is sufficient knowledge to classify data within the scale.

If multiple characteristics are considered relevant for the land use, typically the various ratings need to be numerically combined to derive a single evaluation score. This requires normalizing the number of ratings for each characteristic and evaluating the collection of characteristics for how important they are to the assessment. Normalization ensures a consistent valuation of degrees of distinction. For example, if one characteristic is described with seven ratings between excellent and poor and another with five, the two scales should be assigned numerical values that fall within the same range (restated along a scale of 1 to 10). Determining the importance of each characteristic in assessing the targeted land use allows for adjustments to the additive score to reflect relative contribution to the assessment. If the characteristics are equally informative, then they can all be weighted equally (weighting of 1). However, if one characteristic is more important, it can be assigned a weighting which, when multiplied against the rating scores, will numerically emphasize that characteristic.

Once ratings and weights have been appropriately assigned, a score is determined for each area being evaluated. Area may mean different things depending on the data available to the study. If property ownership boundaries already exist, then each property can be evaluated as a distinct area and assigned its own

score. In the absence of property boundaries, the study area needs to be divided up into areas of homogeneous land characteristics to determine spatially relevant scores. A spatial intersection of the landscape characteristics for the targeted land use will produce these homogeneous areas—landscape units that share the same classification for each characteristic. For example, intersecting a soil and slope map might identify one contiguous area with silty loam soil and a 1 to 3 percent slope, and a neighboring area with silty loam soil but a 4 to 6 percent slope.

#### **4.6.8 Explore Acquisition Potential**

Once the scores have been calculated, the distinct areas or properties can be prioritized for acquisition investigation. If property ownership data was not initially available, the land areas scored by landscape characteristics can be used to guide specific development of property boundaries and collection of ownership, valuation and current use data. Other issues to consider when prioritizing properties are proximity to the installation, ease of access, unit size, and characteristics of neighboring properties (neighboring “moderately suitable properties” might be considered more valuable than each property alone because they could be managed together).

The study participants should devise a method for cost-benefit evaluation of acquiring the property. Cost determination should include any predicted restoration or management expenses along with the market value of the property. The operating expenses could be estimated by the land use expert, perhaps based on experiences with land management on the installation or for other conservation lands. A local real estate expert would be able to determine whether assessed value was a good indicator of market value, or identify similar properties that were recently sold as a proxy market estimate. Benefits determination could include the predicted mitigation of training restrictions (in acres or training days per year), reductions in on-post conservation management costs, and increases in individual endangered species.

## 5 Summary and Recommendations

### 5.1 Summary

The tremendous amount of growth and urbanization that has occurred since World War II has changed the landscape of the nation. Military installations can no longer be considered isolated and self-sufficient entities with no responsibilities to the region in which they reside. Virtually every military installation is at risk for some type of encroachment issue. Some are certainly farther along this path than others, but the increasing demanding regulatory climate and urbanization patterns indicate a continued and increasing pressure on installations. This study recommends and describes a process for addressing encroachment issues in a broader context that brings the installation's requirements into focus with regional objectives and goals. The encroachment issue is a subset of the sustainability issue. Military installations will be required to address this larger issue in the not too distant future. An installation that focuses solely on its military mission and ignores the sociopolitical and environmental issues in the region does so at its own peril. A proactive stance where the installation increases its public involvement in the region through educational activities, partnerships, regional planning, and ecoregional problem solving will greatly enhance the installation's long term viability.

The Army must strive to maintain a reasonable balance between test and training requirements, the concerns of installation neighbors, and the importance of sound environmental stewardship. Maintaining this balance is a difficult proposition, but one that the Army must continue to pursue, in concert with other agencies, and with local communities.

To this end, decisions affecting this balance should be made within the geographical context of the ecoregion. Ecoregions are large geographic areas that support distinctive groupings of species and ecological communities due to environmental conditions such as climate and geology (Stein, Kutner et al. 2000). Taking an ecoregional perspective, by definition, means that installation commanders must work issues from the perspective of both inside and outside the fence. Using the ecoregion as the planning context greatly enhances the range of options for meeting defined natural resource requirements and preventing future natural resource requirements from negatively impacting the mission. It is im-

portant to note that not every environmental or natural resource use issue must or should be satisfied by the sole actions of the installation. The burden and benefits of maintaining the viability of the ecoregion can be shared among inhabitants of the region. Shared responsibilities broaden the range of solutions and integrate the installation's activities with those of other responsible parties in the region.

This work summarizes policies and the legal framework for addressing encroachment on Army installations (Chapter 2). Specific "lessons learned" based on the experiences with the Private Lands Initiative at Fort Bragg and similar activities at other installations were outlined and analyzed (Chapter 3). Chapter 4 outlines a multi-step process for encroachment mitigation that takes a holistic approach. This recommended process must be proactive and ongoing. Encroachment issues are not going to "go away"; as one issue is resolved, another replace it in time. A continuous process of risk assessment is recommended, as are modeling and impact assessment, policy intervention and action taking, and starting the cycle again. Installations are becoming more sophisticated in the integration of management issues, whether they are cultural resource, natural resources, or the built environment. Addressing these issues will not be cheap or easy. Encroachment is a multi-faceted problem and complex solutions are required for complex problems.

## **5.2 Recommendations**

### **5.2.1 *Command Emphasis***

Leadership counts. There must be a visible and viable commitment from the top of the Army to move away from a compliance-based approach to installation sustainability. Stewardship and public responsibility need to have equal footing with training and mission accomplishment. It is through this triad that the mission can truly be sustained. By proactively and earnestly addressing the other two parts of the triad, crucial aspects of mission accomplishment will not have to be compromised. Not fully engaging environmental and public needs leads to the incompatibilities with mission accomplishment and the very issues of encroachment. This visible and viable commitment also includes the balanced division of resources to allow collaborative participation with those outside the military. This requires an integrated approach that sustains the mission, the public, and the environment.

### **5.2.2 Cooperative Agreements**

Cooperative Agreements may be useful at some Army installations, despite the fact that they have a high cost and are long-term in nature. It is recommended that installations carefully consider the potential of successful CA implementation since CAs may succeed in reducing respective encroachment issues.

The Army needs clear legislative authority empowering installation commanders to work outside the fence-line in those circumstances where encumbrance of adjacent private lands will directly support military mission. At the Headquarters, Department of the Army level, policy makers, relying on existing law or new legislative initiatives, should revise existing policies and procedures to authorize and encourage installation participation in such initiatives. On the local level, installations must overcome outdated stereotypes of non-profit conservation organizations that are willing to participate as partners in solving critical encroachment problems. The hard work, expertise, and flexibility of private organizations have resulted in successes at the installations noted in the case studies. The case studies should serve as examples for future Army initiatives in encroachment mitigation since a program that encourages and enables the ownership of private developable lands to be converted to conservation organizations such as TNC has the potential to greatly benefit the sustainment and transformation of the modern Army. In the future conservation organizations may be the best possible installation neighbors, provided the Army truly accepts its natural and cultural resource responsibilities and bargains in good faith.

New Army policy is recommended to enhance this method and encourage installations to partner with neighbors for the acquisition of conservation easements off of the installation to meet installation management objectives. Funds must be programmed to support this initiative. It is recommended that AR 200-3 be changed to highlight these opportunities as natural resource management techniques.

### **5.2.3 Installation Master Planning**

AR 210-20, Master Planning for Army Installations, attempts to address some of the issues that lead to encroachment. Real property master planning is just one aspect of installation planning. AR 210-20 does have some of the right words—Chapters 2 and 3 touch on the issues, but the regulation lacks hard hitting implementing guidance for the philosophies espoused in the overview. The planning process is too internally focused. The regulation needs more emphasis on developing a regional focus with sustainability and strategic planning incorporated as an integral part of the planning process. It is those issues outside the

fence combined with those inside the fence that will cause problems. Integration of natural and cultural resource issues, regional planning linkages, bioregional approaches, and sustainability need to be addressed more completely in the regulation. The philosophy outlined in the general comments, above, for installation management needs to be incorporated into installation master planning. In fact, master planning needs to transition to sustainability planning (EDAW 1999). The planning process should include and not be limited to:

- enhancing the relationship between nature and the built environment
- establishing the natural context as the framework for the built environment
- incorporating human development into that natural context at all scales
- accepting sustainability as a value system across all levels
- using the continuous and iterative character of the planning process to incorporate the values of sustainable development.

By integrating long-range environmental considerations into their proactive planning process, installations can minimize potential problems. Strategic installation planning incorporates natural resource, cultural resource, and environmental management. This will help installations understand and assess future environmental and encroachment risks and opportunities, so they can make informed decisions about their facilities and mission accomplishment.

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## Appendix A: Selected Risk Indicators for Encroachment Related Land Use Issues

Issue	Stressors	Indicators	Data	Indicator Calculation	Risk Definition		
<b>Air Quality</b>	<i>Emission Status</i>	Non-attainment area	Ambient Conditions for Criteria Pollutants	Any pollutant non-att = Yes	No=low, yes=high		
<b>Urban Development</b>	<i>Community Size</i>	Regional Population Density	20-Mile Population (MPop)	MPop/TA	<100=Low, 100-250=Med, >250=High		
			20-Mile Area (TA)				
		State Degree of Population Urbanization	Metropolitan Population (MPop)	MPop/Spop (%)		<50=High, 50-75=Med, >75=Low	
			State Total Population (SPop)				
		Degree of MSA Land	Metro Area (MA)	MA/SA (%)			<20=Low, 20-50=Med, >50=High
			State Area (SA)				
	Degree of Regional Land Urbanization	20-Mile Buffer Developed Area (DA)	DA/TA (%)	<29=Low, 29-35=Med, >35=High			
		20-Mile Buffer Area (TA)					
	<i>Community Economic Strength</i>	Regional Population Growth	Pop Growth 1990-1997 (PG9)		Population growth (%)	<2=Low, 2-7=Med, >7=High	
		Increasing Regional Growth Rate	Pop Growth 1990-1997 vs. Growth 1980-1990		Ratio	<1=Low, >1=Med	
		Earnings Per Capita Growth	Earnings Growth 1990-1997 (EG9)		Earnings growth (%)	<29=Low, 29-35=Med, >35=High	
		Urban Development Growth	Urban Land Growth 1987-1997		Growth rate (%)	<25=Low, 25-50=Med, >50=High	
<i>Community Proximity</i>	Contiguous to Large Metro	Installation abutting or near large urban area	Nearby MSA size	<100k=Low, 100-300k=Med, >300k=High			
<b>Social and Economic</b>	<i>DoD Impact</i>	Military Employment Change	Level of Change		<0=Med, >0=Low		
		Military Employment vs. Total Employment	Military Employment (ME)	(ME/TE)	<10=Med, >10=Low		
			Regional Employment (RE)				
		Military Employee Density	Military Employment (ME)	(ME/MPA)	Density indicates potential per person contribution to local economy	<.05=High, .05-.1=Med, >.1=Low	
Military Property Area (MPA)							

Issue	Stressors	Indicators	Data	Indicator Calculation	Risk Definition
<b>Natural and Cultural Resources</b>	<i>Natural Resource Context</i>	Integrated Natural Resources Management Plan (INRMP)	—	INRMP in Effect = Yes	No=High, Yes=Low
		Endangered Species Management Plan (ESMP)	—	ESMP in Effect = Yes	Yes=High, No=Low
		Jeopardy Biological Opinions	—	JBO Rendered=Yes	No=low, Yes=high
		Training Restrictions (internal)	—	Restrictions in Effect=Yes	Yes=High, No=Low
		Regional T&E Issues	Regional Species Listed	Number of Animal Species	<3=Low, 3-6=Med, >6=High
	<i>Cultural Resource Context</i>	Integrated Cultural Resources Management Plan (ICRMP)	—	ICRMP in Effect = Yes	No=High, Yes=Low
		Planning Level Surveys	—	PLS Complete = Yes	No=High, Yes=Low
<b>Water Resources</b>	<i>Watershed Withdrawals</i>	Regional Fresh Water Consumption Growth	Total FW Watershed Withdrawals 1995	Ratio of Growth over time	<11=Low, 11-20=Med, >20=High
			Total FW Watershed Withdrawals 1985		
		Regional Ground Water Fraction of Total	Ground Water Total (GW)	GW/WT (%)	<11=Low, 11-20=Med, >20=High
			Total Withdrawals (WT)		
	Regional Domestic Water Fraction of Total Withdrawals	Domestic Water Total (WD)	WD/WT (%)	<11=High, 11-35=Med, >35=Low	
		Total Withdrawals (WT)			
	<i>Watershed Health</i>	Index of Watershed Indicators	IWI Score	Scores range from 1 to 6	1,2=Low 3,4=Med 5,6=High
Impaired Waters		EPA Evaluation	Yes or No	No=Low, Yes=Med	
<b>Noise</b>	<i>External Noise Impact</i>	Noise Impact Factor	Complaints (CF)	CF/2 + LF	0-1=High, 2-4=Med, >4=Low
			Claims/Lawsuits (LF)		

## Appendix B: Army Installations by Risk Category

### B.1 Category I Installations

#### *B.1.1 Maneuver Installations*

These major Army power projection platforms that provide the facilities and resources to house, sustain, maintain, train and deploy major combat forces to meet the demands of the National Military Strategy. These installations support both Active Army and Reserve Component forces that do not have ready access to required services or training areas. Maneuver installations also provide the capability to conduct developmental and operational testing and experimentation and to test organizational and doctrinal concepts for future forces.

Fort Bragg, NC

Fort Campbell, KY

Fort Carson, CO

Fort Drum, NY

Fort Hood, TX

Fort Lewis, WA

Fort Riley, KS

Fort Richardson, AK

Fort Wainwright, AK

Schofield Barracks, HI

Fort Stewart/Hunter Army Airfield, GA

#### *B.1.2 Training Installations*

These installations house the schools for each Army branch where doctrine is written; functional training occurs for officers, noncommissioned officers and enlisted personnel; leader development is accomplished. These installations also include facilities for initial entry training. Training locations also provide specialized training, such as language training, and the capability to conduct developmental and operational testing and experimentation and to test organizational and doctrinal concepts for future forces.

Fort Benning, GA

Fort Bliss, TX

Fort Eustis/Story, VA

Fort Gordon, GA

Fort Huachuca, AZ

Fort Jackson, SC

Fort Knox, KY	Fort Lee, VA
Fort Leonard Wood, MO	Fort Rucker, AL
Fort Sam Houston, TX	Fort Sill, OK

### ***B.1.3. Major Training Areas and Reserve Component Training Sites***

These installations provide the facilities to conduct large-scale unit training for active and Reserve Components, but vary in terms of characteristics, capabilities, and organization. Generally, major training areas do not have active tactical units assigned to the installation.

Camp Atterbury, IN	Camp Blanding, FL
Camp Bullis, TX	Camp Edwards, MA
Camp Grayling, MI	Camp Gruber, OK
Camp Guernsey, WY	Camp Perry, OH
Camp Rilea, OR	Camp Ripley, MI
Camp Robert, CA	Camp Robinson, AK
Camp Santiago PR	Camp Shelby, MS
Camp Williams, UT	Devens Res Forces Trng Area, MA
Fort A.P. Hill, VA	Fort Chaffee, AK
Fort Dix, NJ	Fort Hunter Liggett, CA
Fort Indiantown Gap, PA	Fort Irwin, CA
Fort McCoy, WI	Fort Polk, LA
Fort Pickett, VA	Gowen Field, ID
Parks Reserve Forces Training Area, CA	Yakima Training Center, WA.

### ***B.1.4. Proving Grounds***

These facilities support developmental tests to evaluate the battlefield application of new technologies over a wide range of terrain and climatic conditions. Testing includes all types of equipment and munitions, including specialized weapon systems.

Dugway Proving Ground, UT

White Sands Missile Range, NM

Yuma Proving Ground, AZ

### ***B.1.5. Ammunition Production Facilities***

These facilities manufacture, receive, issue, store, renovate, test and demilitarize conventional and chemical ammunition; provide quality assurance for special ammunition; and depot storage for ammunition and strategic materials.

Badger Army Ammunition Plant	Cornhusker Army Ammunition Plant
Crane Army Ammunition Activity*	Holston Army Ammunition Plant*
Iowa Army Ammunition Plant*	
Lake City Army Ammunition Plant*	
Lone Star Army Ammunition Plant*	
Longhorn Army Ammunition Plant	
Louisiana Army Ammunition Plant	
McAlester Army Ammunition Plant*	
Milan Army Ammunition Plant*	
Mississippi Army Ammunition Plant*	
IN Army Ammunition Plant	
Radford Army Ammunition Plant*	
Ravenna Army Ammunition Plant	
Riverbank Army Ammunition Plant	
Scranton Army Ammunition Plant	
Sunflower Army Ammunition Plant	
Twin Cities Army Ammunition Plant	
Volunteer Army Ammunition Plant	

An asterisk indicates Active Plants

## **B.2 Category II Installations**

### ***B.2.1. Ammunition Storage Facilities***

These facilities receive, store, maintain, demilitarize, and out load conventional and special ammunition, forming the wholesale base for the Army as well as other services in its role as the Single Manager for Conventional ammunition. This includes other commodities such as missiles, including the Army's and other services support through inter-service support agreements.

Blue Grass Army Depot, KY

Deseret Chemical Depot, UT\*

Hawthorne Army Depot, NV

Pueblo Chemical Depot, CO\*

Sierra Army Depot, CA

Tooele Army Depot, UT

Umatilla Chemical Depot, OR\*

\*Facilities close at the end of the Chemical Demilitarization mission.

### ***B.2.2. Depots***

Depots overhaul, rebuild, modify, convert, repair and fabricate Army equipment; support the sustainability of the force by replenishing Army equipment stocks; and provide on-site technical assistance to field units.

Anniston Army Depot, AL

Corpus Christi Army Depot, TX

Letterkenny Army Depot, PA

Red River Army Depot, TX

Tobyhanna Army Depot, PA

### ***B.2.3. Industrial Facilities***

Industrial facilities include unique manufacturing plants that manufacture specific end items of military equipment and components.

Lima Tank Plant, OH

Pine Bluff Arsenal, AK

Rock Island Arsenal, IL

Watervliet Arsenal, NY

### ***B.2.4. Ocean Terminals***

Ocean terminals support the deployment of U.S. based forces by conducting transportation engineering, traffic management, and terminal operations and providing terminal facilities as well as staging areas for forces and materiel.

Sunny Point Military Ocean Terminal, NC

## **B.3 Category III Installations**

### ***B.3.1. Command & Control and Administrative Support Installations***

These installations provide facilities through which the Army exercises command, control, and management of the organizations that generate and sustain forces. Many installations in this category provide housing and other quality of life services for soldiers and their families.

Fort Belvoir, VA	Fort Buchanan, PR
Fort Gillem, GA	Fort Hamilton, NY
Fort McPherson, GA	Fort Meade, MD
Fort Monroe, VA	Fort Myer, VA
Fort Sam Houston, TX	Fort Shafter, HI
Kelly Support Center, PA	

### ***B.3.2. Military Treatment Facilities***

Medical centers provide patient care, graduate medical education, and medical research for the Army and for the Department of Defense. As noted, most of these are hosted on installations in the various categories.

Brooke Army Medical Center, Fort Sam Houston, CO  
Dwight David Eisenhower Army Medical Center, Fort Gordon, GA  
Landstuhl Regional Medical Center, Landstuhl, Germany  
Madigan Army Medical Center, Fort Lewis, WA  
Tripler Army Medical Center, Oahu, HI  
Walter Reed Army Medical Center, Washington, DC  
Womack Army Medical Center (Fort Bragg, NC)

### ***B.3.3. Professional Development Installations***

These installations host schools and training centers for military education of Army military personnel and civilian employees.

Carlisle Barracks, PA  
Fort Leavenworth, KS  
Fort McNair, Washington, DC  
Presidio of Monterey, CA  
West Point, NY

#### ***B.3.4. RDT&E Oriented Locations***

These installations host integrated centers for research, development, test and evaluation, including engineering; fielding, and sustainment of weapon systems; laboratories; National Inventory Control Points; and acquisition:

Aberdeen Proving Ground, MD

Adelphi, MD

Cold Regions Research & Engineering Laboratory, NH

Construction Engineering Research Laboratory, IL

Detroit Arsenal, MI

Fort Detrick, MD

Fort Greely, AK (realigning)

Fort Monmouth, NJ

Picatinny Arsenal, NJ

Redstone Arsenal, AL.

## Appendix C: Agencies and Organizations Interested in Land Use Issues and Potential Cooperative Agreement Partners

### C.1 Federal Level Agencies:

#### ***U.S. Department of the Interior - Fish and Wildlife Service -***

<http://www.fws.gov/>

- Conservation of fish, wildlife, plants, and habitats
- Threatened and Endangered Species
- National Wildlife Refuge System

The USFWS works in partnership with many organizations and individuals. Fish and wildlife conservation requires coordinated efforts by the states and the territories, as well as private landowners, tribes, and other countries besides the United States. The list below provides a starting point for finding the state agencies that manage fish and wildlife resources. Links to all the state organizations are at:

<http://offices.fws.gov/statelinks.html>

#### ***U.S. Geological Survey—Biological Resource Division -***

<http://biology.usgs.gov/>

The Biological Resource Division (BRD) works with others to provide the scientific understanding and technologies needed to support the sound management and conservation of our Nation's biological resources.

The following general principles guide the implementation of its mission and form the basis of its strategic planning:

- BRD develops scientific and statistically reliable methods and protocols to assess the status and trends of the Nation's biological resources.

- BRD uses tools from the biological, physical, and social sciences to understand the causes of biological and ecological trends and to predict the ecological consequences of management practices.
- BRD leads in the development and use of the technologies needed to synthesize, analyze, and disseminate biological and ecological information.
- BRD enters into partnerships with scientific collaborators to produce high-quality scientific information and partnerships with the users of scientific information to ensure this information's relevance and application to real problems.
- BRD provides reliable scientific information to all American citizens while recognizing a special obligation to serve the biological information needs of Department of the Interior bureaus.

**U.S. Department of Agriculture—Forest Service - <http://www.fs.fed.us/>**

During the past decade, the United States has strengthened its commitment to sustainable forest management in response to an international consensus to link natural resource development and protection of the environment. Sustainability has been the essence of U.S. Department of Agriculture Forest Service (USDA Forest Service) land and natural resource management from the very beginnings of the National Forest System (NFS). The USDA Forest Service remains committed to managing the 191 million acres of the NFS in a sustainable manner in collaboration with the American public; interested organizations; private landowners; State, local and Tribal governments; Federal agencies; and others. The USDA Forest Service responsibilities associated with the NFS, Research and Development, and State and Private Forestry programs hold opportunities to pursue and achieve the promise of sustainable forest management.

## **C.2 State Level Agencies:**

### ***Departments of Conservation and Natural Resources***

- Smart Growth
- Farmland Preservation
- Environmental Sustainability
- Sustainable Forestry
- Water Quality
- Clean Air
- Groundwater Contamination and Remediation
- Coastal Management
- Soil and Water Conservation

- Groundwater Resources
- Parks and Recreation to include Natural Heritage

#### ***Wildlife Commissions and Fish and Wildlife Services***

- Threatened and Endangered Species
- Habitat Issues
- Wildlife Management

#### ***Departments of Agriculture and Consumer Services (may be separate)***

- Threatened and Endangered Plants
- Plant Conservation

#### ***Departments of Forestry***

- Timber
- Wildlife
- Water Quality
- Recreation Lands

#### ***Departments of Transportation***

- Habitat restoration and preservation to ameliorate impact of road construction

### **C.3 Private Organizations:**

#### ***Land Trust Alliance - <http://www.lta.org/>***

Links and lists of other land trusts within the organization:

<http://www.lta.org/resources/links/>

Founded in 1982, the Land Trust Alliance is the national leader of the private land conservation movement, promoting voluntary land conservation across the country and providing resources, leadership and training to the nation's 1,200-plus nonprofit, grassroots land trusts, helping them to protect important open spaces.

The Land Trust Alliance provides an array of programs, including direct grants to land trusts, training programs, answers to more than 3,000 inquiries for tech-

nical assistance each year, and one-on-one mentoring to help land trusts build organizations that are equipped to protect open space.

The Land Trust Alliance promotes voluntary land conservation and provides leadership, information, skills and resources to land trust organizations.

***The Natural Areas Association - <http://www.natareas.org/frame.htm>***

The mission of the Natural Areas Association is to advance the preservation of natural diversity. The Association works to inform, unite, and support persons engaged in identifying, protecting, managing, and studying natural areas and biological diversity across landscapes and ecosystems. To enhance communication among various state natural areas programs, a group of individuals, primarily from the Midwest, formed the Natural Areas Association in 1980 as a not-for-profit organization. All persons concerned with the identification, evaluation, management, protection, and study of natural areas and other elements of natural diversity were encouraged to join. Today, members include professional and volunteer researchers, natural area managers, naturalists, and conservationists working for both public agencies and private organizations, university faculty, and other interested individuals.

The Natural Areas Association does not own or manage any natural areas, nor does it promote a particular approach to natural area protection. Rather, it provides support and information services to persons concerned with the protection and long-term stewardship of natural areas.

***The Nature Conservancy - <http://nature.org/>***

Since 1951, TNC has been working with communities, businesses, and people to protect more than 92 million acres around the world. Their Mission is to preserve the plants, animals, and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive. Total acres protected by the Conservancy in the United States: 12,621,000. TNC has chapters in all 50 states and chapters or partners throughout the America and the Asian Pacific. TNC has a Cooperative Agreement with the Department of Defense declaring a policy of cooperation and established procedures for planning and conducting cooperative efforts between the TNC and DoD on DoD lands. Installation commanders can obtain technical assistance from the TNC and allow TNC to study significant ecosystems under the Army's control.

**Soil and Water Conservation Society - <http://www.swcs.org>**

The Soil and Water Conservation Society fosters the science and the art of soil, water, and related natural resource management to achieve sustainability. They promote and practice an ethic recognizing the interdependence of people and the environment.

Links to chapters: [http://www.swcs.org/f\\_aboutSWCS\\_whoare.htm](http://www.swcs.org/f_aboutSWCS_whoare.htm)

**The National Wildlife Federation - <http://www.nwf.org/>**

The National Wildlife Federation is the nation's largest member-supported conservation group, uniting individuals, organizations, businesses, and government to protect wildlife, wild places, and the environment. The National Wildlife Federation's Smart Growth and Wildlife campaign is working across the United States to protect and restore species and habitats threatened by sprawl, by promoting "smart growth" alternatives.

Links to regional field offices - <http://www.nwf.org/nearyou/index.html>

NWF's state affiliates are autonomous statewide organizations, which support the purposes and objectives of NWF. Affiliates operate on the grassroots level by working to educate, encourage, and facilitate the conservation efforts of their distinct bases of members and supporters. Affiliation is a voluntary relationship between the state organization and NWF, and there is only one NWF affiliate per state. NWF's nationwide network of 46 state affiliates is also responsible for setting NWF's conservation policy priorities and electing key members of NWF's leadership through an annual resolution process. Links to state affiliates - <http://www.nwf.org/affiliates/>.

**The National Fish and Wildlife Federation - <http://www.nfwf.org/>**

The National Fish and Wildlife Foundation's mission is to conserve healthy populations of fish, wildlife, and plants, on land and in the sea. They use partnerships, sustainable solutions, and better education. The Foundation meets these goals by awarding challenge grants to projects benefiting conservation education, habitat protection and restoration, and natural resource management. The National Fish and Wildlife Foundation funds projects to conserve and restore fish, wildlife, and native plants through challenge grant programs. The challenge grants address priority actions promoting fish and wildlife conservation and the habitats on which they depend. They work to involve other conservation and community interests, leverage Foundation-provided funding, and

evaluate project outcomes. Federal, state, and local governments, educational institutions, and nonprofit organizations can apply for a general challenge grants.

***American Farmland Trust - <http://www.farmland.org>***

American Farmland Trust is a private, nonprofit organization founded in 1980 to protect our nation's farmland. AFT works to stop the loss of productive farmland and to promote farming practices that lead to a healthy environment. Links to regional chapters and organizations

<http://www.farmland.org/regions/index.htm>

***Urban Land Institute - <http://www.uli.org/>***

The mission of the Urban Land Institute is to provide responsible leadership in the use of land to enhance the total environment. ULI's strategic direction is to extend its industry leadership to bring together the people able to influence the outcome of important issues related to land use and the built environment; communicate who they are and what they have learned about land use to increase ULI's influence on land use policy and practice; and continue to provide relevant and current information about land use and real estate development to members and stakeholders.

***Growth Management Institute - <http://www.gmionline.org/home.htm>***

The Growth Management Institute is a small nonprofit organization established to encourage effective and equitable management of growth and change in human habitats. The Institute promotes strategies and practices to achieve sustainable urban development and redevelopment in harmony with conservation of environmental qualities and features.

The Institute was founded in 1992. Its work is guided by a group of distinguished practitioners and scholars recognized nationally as experts in the field of growth management. The Institute provides a forum for constructive exchange of ideas and information about growth management. Occasionally, the Institute also sponsors research and educational endeavors that address major issues of the day.

***Ducks Unlimited - <http://www.ducks.org/>***

The mission of Ducks Unlimited (DU) is to fulfill the annual life cycle needs of North American waterfowl by protecting, enhancing, restoring and managing important wetlands and associated uplands. DU's conservation efforts focus on sustaining or improving the production and survival of waterfowl. These programs simultaneously provide broad benefits to countless organisms, including many endangered species, and to the conservation of biodiversity. DU's program is advanced through partnerships and the outright purchase of land or easements to preserve and create habitat.

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7

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