APPROVAL OF LAND USE AND REAL ESTATE INVESTMENT STRATEGIES IN SUPPORT OF REAL PROPERTY MASTER PLANNING

FORT HUACHUCA, ARIZONA

DRAFT ENVIRONMENTAL IMPACT STATEMENT

APRIL 1998

Environmental and Natural Resources Division
Directorate of Installation Support
U.S. Army Garrison, Fort Huachuca, Arizona

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HOW THIS DEIS IS ORGANIZED

The EXECUTIVE SUMMARY briefly describes the proposed action and no action alternative. Direct and indirect inputs are summarized and compared across alternatives and cumulative inputs briefly described.

SECTION 1	INTRODUCTION discusses the purpose and need for the proposed action, Real Property Master Planning process and components, scope of the DEIS, previous environmental studies used to support this DEIS, a brief description of the NEPA process, and the results of the scoping process.
SECTION 2	DESCRIPTION OF ALTERNATIVES discusses the three alternatives addressed in this DEIS: no action, proposed action, and alternative action. A table comparing impacts across alternatives which is derived from Section 4.0 analysis is presented.
SECTION 3	AFFECTED ENVIRONMENT describes the existing environment.
SECTION 4	ENVIRONMENTAL CONSEQUENCES provides a comparison of environmental consequences associated with the three alternatives: no action, proposed action, and alternative action.
SECTION 5	MITIGATION MEASURES are described in this section.
SECTION 6	UNAVOIDABLE ADVERSE IMPACTS and irreversible and irretrievable commitment of resources associated with the proposed action are described.
SECTION 7	CUMULATIVE IMPACTS are addressed in this section.
SECTION 8	REFERENCES provides bibliographical information for sources cited in the text of the DEIS.
SECTION 9	GLOSSARY provides a definition of technical and other terms
SECTION 10	LIST OF PREPARES
SECTION 11	DISTRIBUTION LIST

A list of ACRONYMNS and ABBREVIATIONS is provided immediately following Section 11.

APPENDIX A	SUMMARY OF HYDROGEOLOGY STUDIES
APPENDIX B	THREATENED AND ENDANGERED SPECIES
APPENDIX C	AIR QUALITY INVESTIGATION
APPENDIX D	NOISE INVESTIGATION
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APPROVAL OF LAND USE AND REAL ESTATE INVESTMENT STRATEGIES IN SUPPORT OF REAL PROPERTY MASTER PLANNING

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APRIL 1998

Environmental and Natural Resources Division
Directorate of Installation Support
U.S. Army Garrison, Fort Huachuca, Arizona

Fort Huachuca
Sierra Vista, Arizona

U.S. Army Corps of Engineers
Fort Worth District

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Science Applications International Corporation
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Phoenix, Arizona

APPROVAL OF LAND USE AND REAL ESTATE INVESTMENT STRATEGIES IN SUPPORT OF REAL PROPERTY MASTER PLANNING

DRAFT ENVIRONMENTAL IMPACT STATEMENT

LEAD AGENCY: Department of the Army
TITLE OF THE PROPOSED ACTION: Approval of Land Use and Real Estate Investment Strategies in Support of Real Property Master Planning
AFFECTED JURISDICTION: Cochise County, Arizona
PREPARED BY: Directorate of Installation Support, U.S. Army Garrison, Fort Huachuca, Arizona
REVIEWED BY: Commander, U.S. Army Garrison, Fort Huachuca, Arizona
APPROVED BY: Commander, U.S. Army Intelligence Center and Fort Huachuca, Arizona

ABSTRACT: In order to meet their prescribed mission, the Army has determined the need to approve updates to three of the four components of the Fort Huachuca Real Property Master Plan: the Long-Range Component, the Short-Range Component, and the Capital Investment Strategy, and authorize the steps leading to project implementation. The fourth component of the Real Property Master Plan, the Mobilization Component, does not require any update at this time and was not evaluated.

Three alternatives are analyzed in this EIS. The no action alternative consists of not approving the three Real Property Master Plan updates. The proposed action is to approve the three Real Property Master Plan updates and authorize the steps leading to project implementation. The other action alternative consists of approving the Long-Range Component update but not the Short-Range Component and Capital Investment Strategy updates. The no action alternative reflects a continuation of baseline conditions at Fort Huachuca. Under this alternative the three Real Property Master Plan component updates may not be approved. Any existing land use conflicts identified in the Long-Range Component within the cantonment area would likely continue. Land use improvements in the cantonment area may not be programmed. Various steps leading to project implementation may not occur. Funding for the projects identified in the Short-Range Component may not be requested and the projects would not be approved as currently programmed.

Approval of the three Real Property Master Plan component updates as discussed in the proposed action would allow Fort Huachuca to establish a framework for managing limited financial and real property resources and ensure installation management is compatible with local community development. Only minor, indirect impacts are attributable to implementing this part of the proposed action. These impacts would be primarily socioeconomic. Under the proposed action, funding may not be available for lower priority projects and activities at some other Department of Defense facilities. Overall, under the proposed action, no significant environmental impacts to cultural resources, air quality, noise, geology and soils, hydrology and water resources, biological resources (including federally listed threatened and endangered species and critical habitat), energy, waste management, or transportation would result. Minor indirect positive impact to land use and personnel safety would result from corrections of land use incompatibilities within the cantonment area.

The other action alternative would consist of approving the Long-Range Component update but not the Short-Range Component and Capital Investment Strategy updates. Failure to approve the Short-Range Component and Capital Investment Strategy updates could slow implementation of corrective land use compatibility measures or, cause implementation to occur in an ad hoc, inefficient fashion. Through careful planning, the Fort has experienced an overall decline in installation water use. In addition, several watershed improvement and recharge studies and biological resource management programs instituted for at-risk environmental resources have established favorable trends in the key areas of water resources, and ecological resources, as well as in other areas of potential impact. For the area immediately surrounding Fort Huachuca (essentially the USPB in Arizona), the short-term trends are also positive in the critical areas of water resources and ecological resources. Over the long-term, however, the continued population increase in the region, which is occurring despite a decline in both population and employment at Fort Huachuca, clouds the picture with respect to water resources and, by extension, ecological resources.

REVIEW COMMENT DEADLINE: Comments must be received by the end of the 45 day formal public comment period as established by the EPA Notice of Availability in the Federal Register. Send comments to Commander, U.S. Army Garrison, ATTN: ATZS-ISB (DEIS), Fort Huachuca, AZ 85613-6000. Comments may also be faxed to (520)533-3043.

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EXECUTIVE SUMMARY

The Army must have quality facilities and infrastructure to support overall mission requirements and provide deployment platforms necessary for national security. The Installation Commander's instrument for unifying planning and programming for installation real property management is the Installation Real Property Master Plan. Carefully developed, the Real Property Master Plan will chart land use and real estate management strategies for achieving the goals of providing excellent facilities and services for soldiers and their families, while supporting the Army's vision for current and future missions.

The proposed action is to approve recent updates to three of the four components of the Fort Huachuca Real Property Master Plan: the Long-Range Component, Short-Range Component, and the Capital Investment Strategy and authorize the steps leading to project implementation. The fourth component of the Real Property Master Plan, the Mobilization Component, does not require any update at this time and was not evaluated.

This draft EIS looks at the land use and real estate investment strategies and the potential impacts of approving updates to the Real Property Master Plan and authorizing the steps leading to project implementation. The potential environmental impacts of implementing specific projects contained in the Real Property Master Plan component updates are not associated with the proposed action analyzed in this EIS but are identified in Appendix F for future reference. As projects are funded, but prior to commitment of resources such as issuing construction contracts, each project will be reviewed to ensure that mission requirements or other intervening changes have not increased or changed the potential environmental impacts related to the projects. Each specific project will be analyzed and documented for compliance with the NEPA according to AR 200-2 guidelines, and may be tiered off this document.

The Army conducted a public scoping meeting in Sierra Vista on August 30, 1994. Approximately 130 people attended the meeting and provided both oral and written comments and suggestions concerning the scope of the proposed EIS. Thirteen citizens, as individuals or as representatives of community organizations, voiced their concerns at the public scoping meeting. Of principal concern to the speakers were the issues of groundwater depletion, water conservation, protection of surface water flows in the San Pedro River and for associated wildlife species; and the socioeconomic impact of increased population on Sierra Vista. These same issues were echoed in the nine written comments solicited from several federal, state, local government agencies, individuals, and representatives of community organizations. These concerns are addressed in this EIS.

The three alternatives analyzed in this EIS are:

- Alternative 1- No Action Alternative. This alternative consists of not approving the three Real Property Master Plan updates (Long-Range Component, Short-Range Component, and Capital Investment Strategy).
- Alternative 2- Proposed Action. This alternative is to approve the three Real Property Master Plan

updates (Long-Range Component, Short-Range Component, and Capital Investment Strategy) and authorize the steps leading to project implementation.

- Alternative 3-Approve the Long-Range Component update but not the Short-Range Component and Capital Investment Strategy updates.

Table ES-1 presents a summary of the environmental impacts of the no action and action alternatives.

Table ES-1. Comparative Analysis of Alternatives

Proposed Action	Alternative Action	No Action
Increased probability of land use compliance within cantonment.	Land use compliance improvements within the cantonment would be approved but not funded.	Land use compliance improvements within the cantonment would not be approved or funded.
Reduced exposure of human and non-human populations to existing emissions.	Benefits associated with projects funding would not occur at Fort Huachuca.	Benefits associated with projects funding would not occur at Fort Huachuca.
Minor, indirect socioeconomic impacts at other DoD facilities not receiving project funding acquired by Fort Huachuca.		

The no action alternative reflects a continuation of baseline conditions at Fort Huachuca. Under this alternative, no additional significant environmental impacts to cultural resources, air quality, noise, geology and soils, hydrology and water resources, biological resources (including federally listed threatened and endangered species and critical habitat), energy, waste management, or transportation would result. Minor indirect impacts to land use and personnel safety would result from continued perpetuation of land use incompatibilities which would not be corrected as demolition and replacement construction or new construction occurs. Minor indirect impact to the regional economy may occur as a result of not approving steps toward the implementation of programmed construction projects

Approval of the three Real Property Master Plan component updates as discussed in the proposed action would allow Fort Huachuca to establish a framework for managing limited financial and real property resources and ensure installation management is compatible local community development. Only minor, indirect impacts are attributable to implementing this part of the proposed action. These impacts would be primarily socioeconomic. Under the proposed action, other DoD facilities may receive less funding, resulting in lower expenditures and a minor reduction in the economic activity in the communities supporting these other DoD locations Overall, under the proposed action, no additional significant environmental impacts to cultural resources, air quality, noise, geology and soils, hydrology and water resources, biological resources (including federally listed threatened and endangered species and critical habitat), energy, waste management, or transportation would result. Minor indirect positive impact to land use and personnel safety would result from corrections of land use incompatibilities within the cantonment. Minor indirect positive socioeconomic impact may occur at Fort Huachuca as a result of approving steps toward the implementation of programmed construction projects

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The other alternative to the proposed action would consist of approving the Long-Range Component update but not the Short-Range Component and Capital Investment Strategy updates. Failure to approve the Capital Investment Strategy and Short-Range Component updates could slow implementation of corrective land use compatibility measures or, cause implementation to occur in an ad hoc, inefficient fashion. Overall, under this alternative, no additional significant environmental impact to cultural resources, air quality, noise, geology and soils, hydrology and water resources, biological resources (including federally listed threatened and endangered species and critical habitat), energy, waste management, or transportation would result. Minor indirect positive impacts to land use and personnel safety would result from corrections of land use incompatibilities within the cantonment. Minor indirect positive socioeconomic impact may occur as a result of approving steps toward the implementation of programmed construction projects.

Cumulative impacts are defined in the CEQ regulations (40 CFR 1500-1508) as those impacts attributable to the proposed action combined with other past, present, or reasonably foreseeable future impacts regardless of the source or agency causing them. There are few, if any, direct or indirect environmental impacts that would result from adoption of the proposed action. Thus there are few if any cumulative impacts and no significant cumulative environmental impacts associated with the proposed action.

However, there is a need to put the minimal impacts of the proposed action into a regional context. To that end, the cumulative impacts of past, present, and reasonably foreseeable future activities that are expected to continue in the region are evaluated.

Through careful planning, the Fort has experienced an overall decline in installation water use. In addition, several watershed improvement and recharge studies and biological resource management programs instituted for at-risk environmental resources have established favorable trends in the key areas of water resources, and ecological resources, as well as in other areas of potential impact. For the area immediately surrounding Fort Huachuca (essentially the USPB in Arizona), the short-term trends are also positive in the critical areas of water resources and ecological resources. Over the long-term, however, the continued population increase in the region, which is occurring despite a decline in both population and employment at Fort Huachuca, clouds the picture with respect to water resources and, by extension, ecological resources.

Another risk to both the water resources and ecological resources of the region is posed by economic activities within the San Pedro River watershed in Mexico. Existing and planned mining activity (USGS 1996) could pose a direct impact to regional water quality. Ongoing expansion of mining activity in northern Mexico, combined with the possible development of at least one additional major mine within the basin, would result in major increases in water consumption upstream of the international border (USGS 1996). Agricultural activities in Mexico along the San Pedro and its tributaries would also impact both water quantity and quality. Entities on the American side of the border that are concerned with the future of the region will have to work closely with their Mexican counterparts to prevent and/or mitigate any environmental impacts that may result.

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Economic and population growth in the remainder of Arizona and Sonora, Mexico, will provide the larger context for the events in the immediate vicinity of Fort Huachuca. A buoyant regional economy supports the continued stability in the Sierra Vista area that is occurring despite the overall reductions in authorized strength at Fort Huachuca. This regional economy has assured the survival of communities such as Bisbee and Douglas, Arizona, despite the loss of major employers that once dominated those towns (Arizona Department of Commerce 1995). This regional economy provides the foundation for supporting the individual communities, and may contribute quantitatively to cumulative impacts on environmental resources in the area of Fort Huachuca.

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1.0 INTRODUCTION

Among their other responsibilities, Army Installation Commanders are also the "mayors" of small cities. As such, they are the directors of change that will guide their communities into the next century. They must ensure that a conceptual blue print is maintained to enable their installations to respond to future Army missions and community aspirations. This blue print must provide for the capability to train, deploy, sustain, and reconstitute today's and tomorrow's military force.

Quality installation infrastructure can be maintained through effective use of resources in a comprehensive investment strategy. This strategy is guided by the long-range and near-term goals and objectives of current and planned missions.

The Army must have quality facilities and infrastructure to support overall mission requirements for the force and provide deployment platforms necessary for national security. The Installation Commander's instrument for unifying planning and programming for installation real property management is the installation Real Property Master Plan (RPMP). Carefully developed, the RPMP will chart a long-term management strategy for achieving the goals of providing excellent facilities and services for soldiers and their families, while supporting the Army's vision for current and future missions.

A well prepared RPMP expresses a long-term concept to provide quality facilities support for the people who must accomplish missions for national defense, now and in the future. Despite careful planning, it should be understood by the reader that at any time, new missions could be added to or removed from Fort Huachuca. These mission changes are not necessarily at the discretion of the Installation Commander. Because of this, specific items or activities proposed or described in the RPMP can change at short notice. Appropriate National Environmental Policy Act of 1969 (NEPA) documentation will be accomplished as these changes arrive and will be tiered from this programmatic document.

1.1 PURPOSE OF PROPOSED ACTION

The Proposed Action is to approve recent updates to three of the four components of the Fort Huachuca RPMP: the Long-Range Component (LRC), Short-Range Component (SRC), and the Capital Investment Strategy (CIS) and authorize the steps leading to project implementation. The fourth component of the RPMP, the Mobilization Component (MC), does not require any update at this time. The purpose of updating these components of the installation RPMP for Fort Huachuca or any other military installation is based on reasoning similar to that which occurs in a civilian community. Through effective and efficient use of available resources, the RPMP's objectives are the creation of a safe community and well managed facilities. The planning method for each is similar; however, the master planning focus for military installations is quite different from that of civilian communities.

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Master planning for military installations is a continuous analytical process that embraces change in existing conditions, technological advancements, and organizational modifications. The planning process involves evaluating present conditions and potential future factors affecting installation construction and management, thereby forming the basis for generating construction objectives and planning proposals to solve current problems and address future needs. The RPMP directs facility construction in a rational manner and describes improvements necessary for continued efficient and economical Army operations. Each step, or element, of the planning process is directed toward the creation of a series of interrelated documents which together comprise an installation RPMP. The purpose of the Proposed Action is to:

1) Establish a vision and future direction for efficiently managing, acquiring or reducing real property assets at Fort Huachuca to effectively support the mission, management processes, and community aspirations.
2) Establish a framework for managing limited financial and real property resources.
3) Determine real property deficiencies and identify costs of addressing the deficiencies.
4) Consider local community land use patterns when developing long term plans for installation facilities management.
5) Identify real estate activities and actions that may have environmental impacts and require additional environmental analyses to ensure compliance with state and federal law.
6) Support the Military Construction Army (MCA), Non-appropriated Fund (NAF), and Host Nation Construction program and projected Real Property Maintenance (RPM) work plan by comparing existing real property to projected real property needs and other developmental or operational activities.
7) Advance the Army Communities of Excellence (ACOE) Program.
8) Ensure installations have the real property assets necessary to support assigned missions.

The purpose of this Draft Environmental Impact Statement (DEIS) is to articulate this vision of how the infrastructure changes will support the mission requirements of the foreseeable future and analyze the potential environmental impacts of the planned infrastructure realignment.

1.2 NEED FOR PROPOSED ACTION

In an era of declining resources and overall downsizing within the Department of Defense (DoD), having an installation RPMP which describes and supports a clear vision of the missions on the installation is more important than ever. The specific needs for the Proposed Action are:

- Implementation of the Proposed Action will allow Fort Huachuca to comply with Army Regulation (AR) 210-20 which requires installations to prepare and periodically update the installation's RPMP.
- Fort Huachuca needs a framework for managing limited resources, facilities and real estate assets in compliance with Army regulations and requirements. This framework also must identify any real property deficiencies and excesses, and establish plans to remedy them.
- The Proposed Action will provide guidance and set priorities for real estate and infrastructure construction activities to support the various missions at Fort Huachuca as reflected in the current Army Stationing and Installation Plan (ASIP) and other Army guidance documents.

The mission requirements reflected in these Army planning and guidance documents include research, development, test, and evaluation activities (RDT&E); training; and administrative and support activities. The cumulative impact section of this DEIS includes a discussion of the major operational and ongoing installation mission and organizational activities at Fort Huachuca.

1.2.1 Facilities Construction

The RPMP SRC includes programmed renovation and construction of facilities projects to support these mission-related activities and provides a planning tool for authorizing the steps leading to project implementation. Most all of the new military construction (MILCON) proposed for Fort Huachuca will occur within the existing cantonment area and within compatible land use areas (Figure 1.2-1). Construction projects proposed in the SRC include several MCA projects and two new Operation and Maintenance Army (OMA) construction projects and several physical upgrades or improvements to existing buildings. Army projects currently programmed for construction within the timeframe of this document are listed in Tables 1.2-1 and 1.2-2. Project specific NEPA coverage for these projects will be provided when, and if, funding is approved and before construction begins, however the currently identified potential impacts are summarized in Appendix F and discussed in the context of potential cumulative impacts in Section 7. Other construction activities proposed by tenant organizations during the timeframe of this document have been or will be addressed in separate NEPA documentation.

1.2.1.1 Installation Demolition Program

Over the next several years considerable demolition will be accomplished in addition to demolition programmed as part of proposed construction projects. In summary, 1998 will see four permanent buildings containing 16,012 square feet (sq.ft.) and 69 temporary buildings with 263,430 sq.ft. demolished, and in 1998 a total of 443,031 sq.ft. will be demolished.

Demolition that may be associated with family housing or projects outside the cantonment would be in addition to the figures and dates reflected in this SRC. An environmental assessment (EA) was prepared to address non construction-related facilities demolition and removal (ENRD 1998a).

1.2.1.2 Other Real Estate Actions

Federal enabling legislation currently exists which allows Fort Huachuca to exchange property with the State of Arizona for full land ownership and the mineral rights to parcels of property located on the East Range at Fort Huachuca. For several years now, Fort Huachuca has investigated this option, as well as other options, in order to acquire title to these East Range parcels. Prior to any decisions, land exchange, or transfer of any property, the proponent of the action(s) will prepare appropriate NEPA analysis. No real estate transfers, sales or exchanges are a part of the proposed action.

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Table 1.2-1 Short-Range MCA Project Listing (FY99-04)

FY	Project Description	Project No.	Scope	Unit of Measure	Funding
2000	Electronic Maintenance Shop	10106	21,300	SF	MCA
2000	CIDC Operations Building	10496	6,350	SF	MCA
2000	*Bowling Center*	*43410*	*24*	*LN*	*NAF*
2000	Whole Neighborhood Revitalization	41494	90	FA	MCA/AFH
2001	Effluent Reuse System	46756			MCA
2001	Renovate Golf Clubhouse & Irrigation	37016	30,000	SF	NAF
2001	Vehicle Maintenance Shop	47283	25,322	SF	MCA
2001	Whole Neighborhood Revitalization	49899	180	FA	MCA/AFH
2002	Whole Neighborhood Revitalization	31429	168	FA	MCA/AFH
2002	*RV Park Expansion*	45967	100	EA	NAF
2002	Electronic Maintenance Shop	47309	21,300	SF	MCA
2003	Whole Neighborhood Revitalization	31430	166	FA	MCA/AFH
2003	Vehicle Maintenance Shop	42779	11,304	SF	MCA
2003	Whole Neighborhood Revitalization	31434	163	FA	MCA/AFH
2004	Youth Center Addition	33321	5,332	SF	NAF
2004	Whole Neighborhood Revitalization	42752	146	FA	MCA/AFH
2004	*Electronic Maintenance Shop*	42782	10,631	SF	MCA

MCA = Military Construction Army NAF = Non-Appropriated Fund AFH = Army Family Housing
LN = Lane SF = Square Feet FA = Family Unit EA = Each

Table 1.2-2. Short Range OMA Project Listing (FY99-04)

FY	Project Description	Project No.
1998	BRAC Area Chapel	SR01
SR	*Defueling Point Ramada & Utility Imp.*	SR02

1.3 REAL PROPERTY MASTER PLANNING PROCESS

The real property master planning process includes analyses that lead to the development of the RPMP. The process provides a means for the effective and orderly management of Army installations. Within the process, the installation master planner analyzes and integrates current and future operational plans of engineer functional areas, other installation staff elements, assigned units, tenant activities, higher headquarters, and surrounding civilian communities. The RPMP is the principal real property management tool in support of overall installation facilities operation, management, and replacement.

Preparation of a RPMP follows well-defined steps, progressing from the general to the specific and from regional considerations to programming a particular facility to meet a specific requirement. The process is accomplished through detailed applications of the general planning methodology. The first phase focuses on goals and objectives, existing conditions, and installation infrastructure. The second phase identifies

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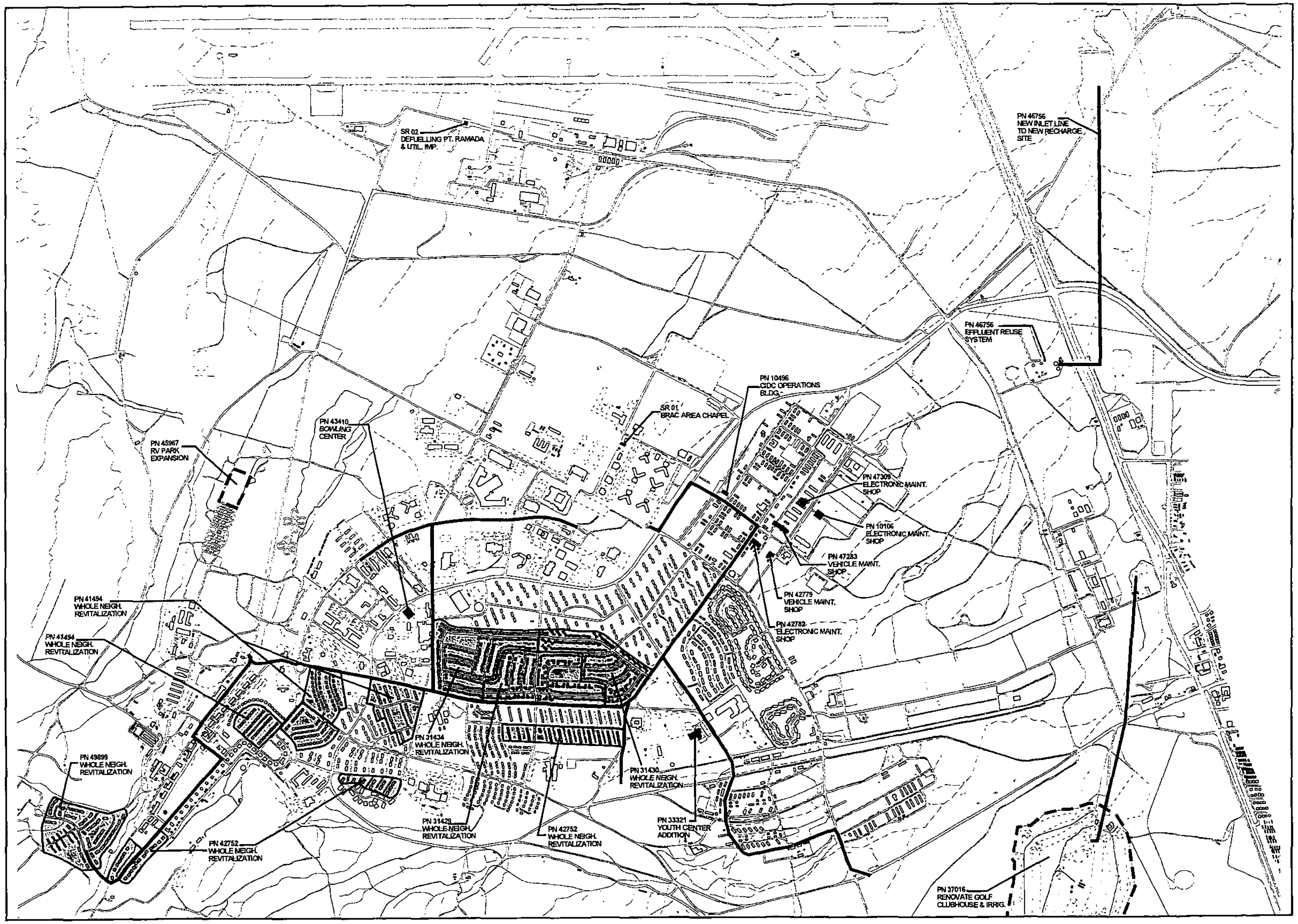

FIGURE 1.2-1

Fort Huachuca: Future Development Plan

- MCA Projects
- OMA Projects
- Effluent System Reuse (PN 46756)
- Whole Neighborhood Revitalization

N

1 0 1 2 Kilometers

SOURCE: Nakata, 1997b

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facility needs, develops alternative solutions, and selects the most appropriate plan and priorities for specific needs. There are nine steps or procedures in the RPMP process, as identified in the US Army Corps of Engineers 1993 Master Planning Instruction. They are:

1) Identify the assigned military units, other tenant activities, and community support organizations (the customers), their missions, and their needs.
2) Apply criteria to the force structure to determine facility and other real property needs and allowances. (By Army regulation, most functions have a specified allowance of space)
3) Identify real property assets.
4) Determine real property deficiencies, excesses, and nonstructural needs (for example, utilities, training areas, and so forth).
5) Define and evaluate alternatives to satisfy deficiencies, eliminate excesses, and satisfy nonstructural needs.
6) Consider developmental constraints including environmental considerations.
7) Identify preferred solutions to satisfy real property requirements.
8) Develop programming actions for prioritization and approval.
9) Involve the customer throughout the entire process.

1.4 RPMP COMPONENTS

The installation RPMP consists of four components (Figure 1.4-1):

1) Long-Range Component (LRC)
2) Capital Investment Strategy (CIS)
3) Short-Range Component (SRC)
4) Mobilization Component (MC)

These documents are available for review at the Sierra Vista City Library. The following information represents a narrative explanation of each component:

1.4.1 The Long-Range Component

The LRC establishes a baseline of existing conditions, expansion capability , and a framework for installation construction goals. It provides the basic direction for long-term management of the installation. It documents installation capabilities, constraints, and opportunities, including environmental and infrastructure analyses. It specifies optimum land use for enhanced mission accomplishment. It identifies the installation's maximum carrying capacity to help in evaluating the potential to accommodate additional missions. It analyzes the installation's management and construction projects in relation to surrounding communities. All other RPMP components are based on the LRC.

The LRC should ideally consist of the following elements:

1) Long-Range Analysis (narrative) of the installation's missions, goals, and objectives.

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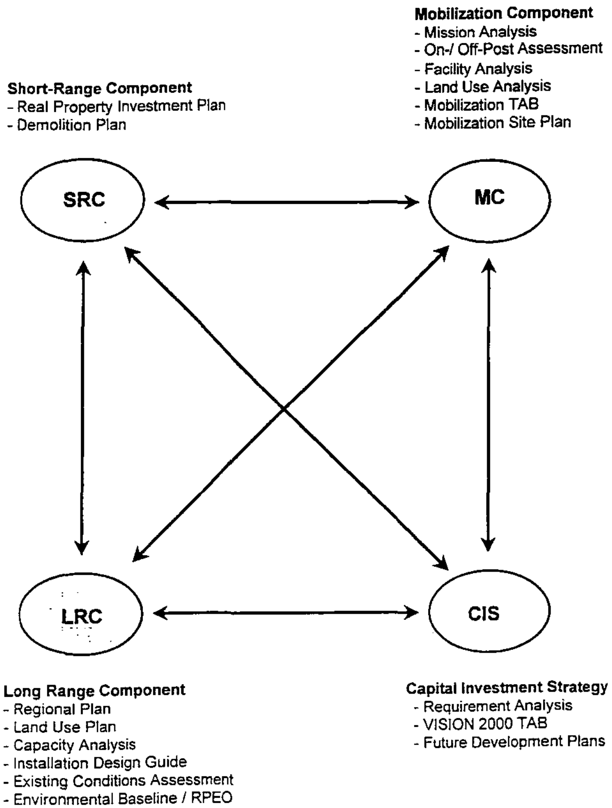

Figure 1.4-1. Real Property Master Plan Components

2) Relationship to surrounding community development; and recommendations for facilities management and construction projects, including the Installation's ability to support changes in mission and expansion by identifying capabilities, constraints, and environmental limitations.

3) Environmental Baseline Analysis (narrative) describing environmental conditions at the installation and the ability of the installation to support assigned missions within its environmental setting.

4) Utility Assessment (narrative) which describes sources, quantity, and quality available.

5) Land Use Analysis (narrative) indicating the optimum land use relationships incorporating all known environmental and operational constraints.

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6) Transportation Assessment (narrative) that depicts how the current and future installation transportation network will support the installation and interface with neighboring community networks.

7) Capacity Expansion Analysis that determines the installation's capability to accommodate additional mission and/or units.

8) Installation Design Guide (IDG) addressing aesthetics and functional development on Installation prepared and attached to RPMP as a separate document.

9) Supporting Graphics: Regional plan, Environmental Overlay map, Land Use Plan, and Expansion Capability Plan.

1.4.2 Capital Investment Strategy

The CIS recommends a systematic plan for investing in real property to achieve the long-range mission support goals. It is the Commander's overall strategy for managing facilities to meet the facility goals of the installation. It is based on the Army Long-Range Facilities Plan and represents the installation's vision of the future. It also documents facility shortages or surpluses, and considers a broad range of alternatives and recommends solutions to fix the shortages and eliminate the surpluses. The CIS must be prepared in enough detail to support the economic feasibility of the solutions. The following elements normally constitute a CIS:

1) Executive Summary giving a short presentation on major issues covered in the CIS

2) Tabulation of Existing and Required Facilities (TAB) that compares facility requirements to existing assets to determine facility shortages and surpluses.

3) Requirements (Alternatives) Analysis that analyzes facility shortages and surpluses identified in the TAB, considers alternatives, and recommends a preferred solution for fixing problem.

4) Environmental Analysis identifying possible environmental impacts with recommendations for environmental documentation.

5) Supporting Graphics which are the Future Development Plans showing areas of expansion, locations of proposed buildings or other facilities, and assets scheduled for demolition or disposal.

1.4.3 Short-Range Component

The SRC is the implementation instrument of the CIS. It identifies specific projects for real property management that reflect the commander's plans to allocate resources to resolve facility shortages and surpluses. It supports Army Planning strategies for force structure development, unit stationing, equipment distribution, and training over a six-year Program Objective Memorandum (POM) period by integrating real property master planning into the Army Operational planning process. It also integrates the facility investment plans of NAF organizations and other separately funded activities. Major Army Command (MACOM) and installation participation in its development is critical. The following elements should constitute the SRC:

1) Overview (narrative) that relates specific projects from all funding sources to the CIS

2) Real Property Investment Plan (RPIP), which identifies specific programming actions to implement the CIS over a six-year POM.

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documents incorporated in general by reference. When a portion of a document is used for detailed reference material on a case-by-case basis, that document is cited within the text, and a specific reference is contained in Section 9, References. The major documents used in the environmental analyses of this DEIS are listed below.

1.6.1 Environmental Impact Statements

Final Supplemental Environmental Impact Statement for Base Realignment at Fort Huachuca, Arizona, August 1992.

1.6.2 Environmental Assessments In Progress

Completion of these EAs includes the public comment period completion.

Routine Maintenance, Repair and Minor Construction on Real Property Involving the Use and Disposal of Hazardous Materials and Wastes at Fort Huachuca, Arizona.

Proposed Upgrade of Training Areas and Facilities at Fort Huachuca. Under preparation by the Arizona Army National Guard (AZ ARNG). Anticipated completion date not established. The AZ ARNG is currently conducting formal consultation with the U.S. Fish and Wildlife Service (USFWS).

Stationing of U.S. Army Reserve Units at Fort Huachuca, Arizona. Under preparation by the US Army Reserves.

1.6.3 Environmental Assessments Completed

1992

Environmental Assessment for the Demolition of WWII Temporary Wood Structures, DEH, December 1992.

Environmental Assessment for the Joint Terminal Information Distribution System Testing at Fort Huachuca, Arizona, March 1992 through December 30, 1992, (undated) 1992.

Environmental Assessment for the U.S. Army Test and Experimentation Command (TEXCOM), Intelligence Electronic Warfare Test Directorate Ground Division Test Bed, January 1992.

Environmental Assessment for the Development of a Forward Operating Base (FOB) for the Advanced Airlift Tactics Training Center (AATTC), Joint Operations Training Site (JOTS), Libby Army Airfield (LAAF), Fort Huachuca, Arizona, May 1992.

Environmental Assessment for the Fiber Optics Line, Fort Huachuca, Arizona, May 1992.

Environmental Assessment for the U.S. Army Electronic Proving Ground (EPG) Communication-Electronic Testing and Use of Test Sites in Southern Arizona and Fort Huachuca, May 1992.

Environmental Assessment for TEXCOM Unmanned Aerial Vehicle-Short Range (UAV-SR), EPG, June 1992.

Environmental Assessment for the Stationing of the M1-IP Main Battle Tank at Fort Huachuca, Cochise County, Arizona, August 1992.

Environmental Assessment for the Construction and Operation of an Applied Instruction Building (AIB) to Accommodate Joint Service Training of UAVs at Fort Huachuca, Arizona, U.S. Army Intelligence Center and School, November 1992.

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Electronic Proving Ground Environmental Assessment for the Renewal of Leases on Sands Ranch and Two Properties on Willcox Playa to Support the EPG Test Mission, November 1992.

Environmental Assessment for the Restructuring of Special Use Airspace at Fort Huachuca, Arizona, November 1992.

Environmental Assessment for the Military Training and Communications-Electronics Testing at Fort Huachuca, December 1992.

1993

Environmental Assessment for the Replace Historic Windows in Family Housing Units, Directorate of Engineering and Housing, Fort Huachuca (DEH); June 1993

Environmental Assessment for the Renovation of Greely Hall, U.S. Army Garrison (USAG), November 1993.

Comprehensive Environmental Assessment for UAVs, March 1993.

Environmental Assessment for the Renewal of a Lease of a 40-Acre Property on the Tombstone Municipal Airport, Arizona to Support the U.S. Army Electronic Proving Ground (USAEPG) Test Mission. June 1993.

1994

Environmental Assessment for the INSCOM Military Intelligence Battalion Low Intensity Restationing, June 1994.

Environmental Assessment for the Construction of an AAFES Mini Mall, Army Air Force Exchange Service (AAFES), May 1994.

Environmental Assessment for the Fielding and Operation of the M-1 Tank at Fort Huachuca, November 1994.

1995

Environmental Assessment for the Renewal of Five-Year Lease of State of New Mexico Property in Hidalgo County, New Mexico & 11th Signal Brigade, June 1995.

Environmental Assessment for Testing the Joint Surveillance Target Attack Radar System (J-STARS) in Southeastern Arizona, November 1995.

1996

Environmental Assessment for Construction and Operation of a Recreational Vehicle Complex at Apache Flats; Fort Huachuca, Arizona; Directorate of Human Resources, March 1996.

1997

1995 Base Realignment and Closure Realignment of Elements of Information Systems Engineering Command to Fort Huachuca, Arizona. April 1997.

The Renewal of Six Joint-use Property Leases and the Continued Use of the Willcox Playa Test Range by Fort Huachuca, Arizona. April 1997.

Establishment of a Western Region Civilian Personnel Operations Center (CPOC) at Fort Huachuca, AZ. U.S. Army Forces Command (FORSCOM) is the proponent. April 1997.

Autumn Air Shows at Libby Army Airfield, Fort Huachuca, Arizona. October 1997.

1998

Programmatic Environmental Assessment, Demolition of Excess Real Property at Fort Huachuca. March 1998.

1.7 DESCRIPTION OF THE NEPA PROCESS

The National Environmental Policy Act of 1969 established the requirement that all major federal actions are to be subject to analysis for impacts on the human environment. Authority for implementation of NEPA resides with the CEQ in accordance with Title II of the Act. The procedures for completing an EIS for an Army installation are specified in AR 200-2 (which may also be found in 32 CFR 651) and follow the process outlined in 40 CFR 1500-1508. AR 210-20, Master Planning for Army Installations, requires that NEPA be integrated into the master planning through an environmental impact analysis (USA COE 1993, section 2-7). The AR 210-20 environmental impact analysis process consists of either the development of an environmental baseline, to be coupled with an EA, or an EIS.

The primary functions of this DEIS are to analyze the impacts of the proposed action, including the impact of the proposed action in the context of cumulative impacts on the environment, and to serve as a resource baseline for future project-specific NEPA documentation. If or when projects are implemented in the future, this document may be incorporated by reference or through the process of tiering. The preparation of this DEIS is a multiple-step process that starts with the formulation of the Proposed Action and alternative(s) and concludes with a Record of Decision (ROD) at the end of the process. Section 1.7.1 outlines the development and history of this DEIS.

1.7.1 Environmental Impact Statement Process

In order to meet their prescribed mission, the Army determined the need for the RPMP update and approval thereof. This approval of the three RPMP component updates and authorization of the steps leading to project implementation constitutes the Proposed Action. Following the determination of alternatives, the Army published a Notice of Intent (NOI) to prepare an EIS in the May 19, 1994 Federal Register (FR Vol. 59, No. 96, page 26214). This action started the scoping process for this DEIS. Scoping refers to the process by which the Army provides responsible agencies (agencies that would make discretionary decisions based on the information contained in the EIS) and the public with information on the alternatives being considered, and information on the types of environmental analysis to be included in this DEIS. As a result of scoping, the Army received information from responsible agencies and the public on additional environmental concerns, analyses, or alternatives to be considered in this DEIS.

This DEIS is made available to agencies, organizations, and the public for review and comment. The Army files a copy of this DEIS with the U.S. Environmental Protection Agency (EPA). Upon receipt, the EPA files a Notice of Availability (NOA) for publication in the Federal Register. The Army also provides review copies to those agencies, organizations, and individuals requesting review copies, and provides copies to public libraries in the area affected by the alternatives considered in this DEIS. After notice is published in the Federal Register, a 45-day (minimum) public review period begins. During the public review period, any interested party can provide written comments to the Army. The Army may also conduct a public hearing on this DEIS for those wishing to get clarification or make verbal comments for the record.

Following the close of the public comment period, the Army prepares a Final EIS. The Final EIS includes changes and modifications to the document that result from comments received during the public comment period. The document is distributed for a 30-day public review to any person, organization, or agency that submitted substantive comments on the DEIS. After this 30-day period expires, the Army will make a decision regarding the Proposed Action. In compliance with AR 200-2, the Army then publishes a ROD to be filed with the U.S. Army Environmental Office.

1.7.2 Description Of The Tiering Process

CEQ regulations encourage agencies to tier their environmental documents to prevent repetitive discussions in order to focus their decision-making processes on the important and relative issues at each level of review (40 CFR 1502.20). The process of tiering refers to the covering of general issues in a broad document, with further focused documents used to address more specific decisions incorporating detailed, action-specific information. AR 200-2 encourages the use of tiering and the incorporation of existing documentation by reference to eliminate repetitive discussions, reduce the bulk of documentation, and to allow reviewers to focus on central issues.

1.8 PUBLIC SCOPING, PARTICIPATION, AND CONCERNS

CEQ regulations that implement NEPA require an early and open process for determining the scope of issues to be covered in the EIS (40 CFR 1506.6). A NOI to prepare this EIS was published in the Federal Register May 19,1994 (FR Vol.59, No. 96, page 26214). The general public, federal, state, and local agencies and organizations were provided an opportunity to raise their concerns regarding the environmental effects of the Proposed Action and alternatives at Fort Huachuca. Persons and agencies were invited to provide comments in writing and/or verbally at a public scoping meeting.

1.8.1 Public Meeting

In keeping with the concept of an open environmental process, the Army conducted a public scoping meeting in Sierra Vista on August 30, 1994. Notices of the time and place of the public scoping meeting were published in seven regional and local newspapers in the vicinity of Fort Huachuca. Those newspapers included the Sierra Vista Herald, Bisbee Daily Review, Douglas Daily Dispatch, Gila Bend Sun, Arizona Republic (Phoenix), East Arizona Courier (Safford), and Arizona Daily Star (Tucson).

Approximately 130 people attended the meeting and provided both oral and written comments and suggestions concerning the scope of the proposed EIS. All public and agency comments received were categorized according to the issues raised, summarized, and considered as part of the EIS analysis. Transcripts of the public scoping meeting were made available to the public through the Chief, Environmental Natural Resource Directorate (ENRD), Directorate of Installation Support (DIS), Fort Huachuca.

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Thirteen citizens, as individuals or as representatives of community organizations, voiced their concerns at the public scoping meeting. Of principal concern to the speakers were the issues of groundwater depletion, water conservation, protection of flows in the San Pedro River and associated wildlife species; and the socioeconomic effect of regional populations. (For a complete record, see official transcripts of Public Scoping Meeting, Fort Huachuca Environmental Impact Statement, August 30, 1994). These same issues were echoed in the nine written comments received from individuals and representatives of community organizations.

These concerns are extensively addressed in this DEIS. Specifically, Section 3.7 includes baseline information on the Upper San Pedro Basin (USPB); water resources of the Sierra Vista subwatershed; water resources of Fort Huachuca; population and water demand; and biological resources. Section 4 includes a discussion of potential direct and indirect environmental impacts on those subject areas. Another chapter (Section 7), deals with the cumulative impact issues underlying most of the public comments provided during the scoping process.

1.8.2 Written Comments

Written comments were solicited from several federal, state, and local government agencies (Appendix H). The U.S. Bureau of Land Management (BLM), which manages the San Pedro Riparian National Conservation Area (SPRNCA), requested that the EIS include an assessment of the direct and indirect effects of groundwater pumping on the regional hydrology (Sections 4 and 7) and on threatened and endangered wildlife species (Sections 4 and 7). The BLM also wanted the EIS to address impacts on land use, recreation, vegetation, soils, and air quality (Sections 4 and 7); and to assess the effects of fire management, over-flights, off-site training, and electromagnetic interference on the environment (Sections 4 and 7).

The USFWS suggested that the EIS should assess the impact of proposed activities on the environment within Fort Huachuca and the surrounding area. They also suggested that the EIS address the on-going water rights adjudication process in the USPB (Section 3.7) and the impacts on federally listed threatened and endangered species on the installation as well as in the surrounding area (Sections 4 and 7).

The EPA provided a detailed list of issues that needed to be discussed in the EIS, including the effect of the Proposed Action on air quality, wetlands, biological resources (including threatened and endangered species), public services, hazardous materials, and minority populations (Sections 4 and 7). The EPA also wanted the EIS to state the relative level-of-significance of the environmental impacts (Section 4), to define the environmental baseline condition (Section 3), to assess cumulative impacts (Section 7), and to develop mitigation plans that correspond to specific impacts (Section 5).

A letter from the Arizona Game and Fish Department (AGFD) requested that the EIS consider the effects that the Proposed Action might have on wildlife corridors, riparian habitat, bat and pronghorn antelope habitats, and hunting and wildlife viewing opportunities (Sections 4 and 7). The AGFD also wanted the EIS to discuss wildlife education programs, the role of fire in habitat management, the Memorandum of Understanding (MOU) between the Department of the Army (DA) and the AGFD, and the staffing of the wildlife program at Fort Huachuca.

Another state agency, Arizona State Parks, commented that the EIS should include a discussion of the preservation of national historic landmarks, protection of prehistoric sites, consultation with Native American groups, and the need for a cultural resources management plan (Section 3.3). In addition, the City of Bisbee requested that the EIS address the impacts of the Proposed Action on housing, water, and the economic base of the local communities (Sections 4 and 7).

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2.0 DESCRIPTION OF THE ALTERNATIVES

Under NEPA, the proponent for an action is responsible for considering alternatives to the proposed action. The alternatives must be within the ability of the proponent to accomplish. For this action, all alternatives deal with approvals, which then allow staff elements on Fort Huachuca to manage the processes outside their headquarters to implement specific projects. Because most funding for actual project implementation is from Military Construction Authorizations, actual implementation is not within the scope of authorization authority of the Installation Commander. This section identifies and describes the three alternatives analyzed in this DEIS. These are:

- Alternative 1: No Action Alternative. This alternative consists of not approving the three RPMP updates (LRC, SRC, and CIS).
- Alternative 2: Proposed Action. This alternative is to approve the three RPMP updates (LRC, SRC, and CIS) and authorize the steps leading to project implementation.
- Alternative 3: Approve the LRC update but not the SRC and CIS updates.

Note that the fourth component of the RPMP, the MC, is not included in any of the proposed alternatives. The MC does not require an update at this time.

2.1 ALTERNATIVE 1: NO ACTION

No action would consist of not approving the three RPMP component updates. In the short term, this alternative would maintain the installation's current real estate and facility infrastructure assets in a static condition. Over the long term this alternative would lead to a deterioration of the Army's ability to conduct its operations and missions at Fort Huachuca. Current operations would continue to depend on existing real estate assets. Water use would continue at approximately 2,357 acre-feet (ac-ft) per year and some water conservation and groundwater recharge projects may not occur. Mission-related real estate requirements such as additional military training facilities, infrastructure, and troop housing are, and would remain, inadequate and frequently substandard. By exercising the no action alternative, the Army would continue to operate with a reduced capability to adequately prepare for existing and future mission requirements

2.2 ALTERNATIVE 2: PROPOSED ACTION

The proposed action is to approve the three RPMP updates (LRC, SRC, and CIS) and authorize the steps leading to project implementation. This includes the approval of currently recommended programmatic changes in the installation's facilities and infrastructure which may be anticipated within the near future. The RPMP updates reflect facilities support required for anticipated changes in the testing, training, and operational activities performed at Fort Huachuca. These changes are documented in official planning guidance such as the Army Plan, Force Structure Component System, Army Modernization Memorandum,

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and ASIP. As a planning tool, the proposed action provides the first major step in providing facilities for the continued support of programs, policies, and activities. The documents associated with the proposed action address facilities construction requirements and siting criteria to support operational activities, and may result in changes to land use, facilities, and infrastructure. Activities supported by the proposed action were identified in Section 1.2. These activities are analyzed in the context of cumulative impacts in Section 7. Individual facilities improvement projects, testing and training activities potentially affecting the environment, and other operational changes have been or will be analyzed under individual or future NEPA documentation tiered from this document.

2.3 ALTERNATIVE 3: APPROVE THE LRC UPDATE BUT NOT THE SRC AND CIS UPDATES

This alternative would consist of approving the LRC update but not the SRC and CIS updates. Approval of the LRC would provide a framework to guide all future construction on the installation within the cantonment area and a capacity and expansion analysis of utilities, buildings, facilities, and developable land in light of environmental issues. The LRC serves as the foundation for all future construction on the installation and a basis for the implementation of projects and facilities proposed in the CIS and SRC. While the LRC is a central component to the RPMP, its usefulness as a planning tool is limited without other components such as the CIS and SRC.

In the short term, this alternative would maintain the installation's current real estate and facility infrastructure assets in a static condition. Land use changes required to correct existing land use incompatibilities and changes to support mission-related real estate requirements such as additional military training facilities, infrastructure, and troop housing would be planned, but the implementation process for these changes would not be provided. By exercising this alternative, the Army would be able to implement land use changes as demolition projects occur and where existing land use incompatibilities exist, but would be unable to implement the programmed facilities construction program and steps leading to project implementation. Under this alternative the installation would continue to operate with a reduced capability to adequately prepare for existing and future mission requirements.

2.4 ALTERNATIVES CONSIDERED BUT NOT EVALUATED

One of the proposed alternatives published in the NOI was to prepare an EIS involving expansions to infrastructure. As a result of budget reductions and downsizing of the DoD, this alternative is not currently reasonable at Fort Huachuca and is not within the authority of the Installation Commander to approve. Therefore it has not been further considered in this document.

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3.0 AFFECTED ENVIRONMENT

3.1 LAND USE

Fort Huachuca is located on the western fringe of the San Pedro River Valley in Cochise County in southeastern Arizona, 75 miles (121 km) southeast of Tucson and approximately 8 miles (13 km) north of the Mexican Border (see Figure 3.1-1). Benson, Arizona is approximately 31 miles (50 km) north of the installation on Interstate 10. Fort Huachuca is comprised of approximately 73,272 acres (114 sq. mi.) situated adjacent to the City of Sierra Vista and near Huachuca City in the foothills of the Huachuca Mountains. The Huachuca Mountains form the southern and western boundaries of Fort Huachuca. The northern border parallels Babocomari River, a tributary to the San Pedro River. The City of Sierra Vista lies immediately to the east of the installation, and serves as a regional residential and commercial center. Huachuca City lies to the north of Fort Huachuca.

Lands surrounding Fort Huachuca are directly affected by Cochise County, Santa Cruz County, and City of Sierra Vista land use restrictions. A large portion of land adjacent to the installation falls under the land use control of the Bureau of Land Management (BLM) and the US Forest Service (USFS) (Figure 3.1-2).

Cochise County zoning districts maintain land use throughout the county. Approximately 90 percent of the unincorporated areas of the county are zoned RU for rural development (Zillgens 1991a). The lands adjoining the installation at the northern, southern, and portions of the western and eastern borders are zoned RU 4 and require a minimum lot size of four acres (Zillgens 1991a). The Transitional Residence (TR) zones along the eastern border of the installation have a minimum lot size of 36,000 sq. ft (3240 sq. m). Additional areas around Huachuca City and along State Highway 92 south of Sierra Vista are classified as urban growth areas.

City of Sierra Vista land use categories consist of seven major categories which all occur along the city's western border with the installation. They include residential, office/professional, commercial, industrial, institution/public or semi-public facility, and park/open space facilities (Figure 3.1-3).

The Sierra Vista Ranger District of the Coronado National Forest encompasses 75,000 acres (117 sq. mi.) of forestland in the Huachuca Mountains immediately to the south and west of the installation. This land is predominately undeveloped and contains very few major access roads, campgrounds, or other high volume recreation facilities. The Forest Management Plans for the Coronado National Forest delineate management areas adjacent to the installation for visual resources, livestock grazing, game habitat, fuel wood harvest, and wilderness (Zillgens 1991a).

The SPRNCA, established by Act of Congress in 1988, is the dominant geographic feature in the San Pedro Basin, and is intensively managed for a variety of wildlife, environmental, and recreational uses (see

Figure 3.1-1). Managed by the BLM, the SPRNCA has as its purpose to protect the riparian area and the aquatic, wildlife, archaeological, paleontological, scientific, cultural, educational, and recreational resources within the authorized boundary of the area. It extends in a publicly owned corridor from the community of Curtis to the north, to a few miles below Hereford, situated immediately north of the Mexican border. The SPRNCA is adjacent to portions of the northeastern boundary of the installation and approximately 10 miles (16 km) separate the boundaries of the two federal reserves to the south. The SPRNCA is approximately 5 miles (8 km) wide at its widest point and encompasses both sides of the San Pedro River.

3.1.1 Installation Land Use

Fort Huachuca is comprised of approximately 73,272 acres (114 sq. mi.) of land excluding the noncontiguous areas. The Fort is divided into an East Reservation (27,215 acres [42 sq. mi.]) and West Reservation (46,057 acres [72 sq. mi.]) by Arizona Highway 90, as shown in the Fort Huachuca Master Plan (Figure 3.1-4). These Reservations are classified generally as either open/operational, or built-up areas and are classified as training ranges or cantonment areas respectively.

The East Reservation includes the East Range and consists almost entirely of open/operational areas. This area includes approximately 13,463 acres (21 sq. mi.) of public domain land withdrawn from public use for military purposes pursuant to the Order of the Secretary of Interior (Public Land Order 1471, 8/22/57). These lands are managed primarily for military training purposes consistent with the stated purpose of the secretarial withdrawal. The Resource Management Plan of the Safford District of the BLM identifies these lands as being managed for military purposes and provides for resource management coordination with Fort Huachuca consistent with the requirements of the Federal Land Protection and Management Act (FLPMA).

The West Reservation includes the West Range, South Range, and cantonment or built-up area (5,270 acres [8 sq. mi.]). To clarify existing land use patterns and characteristics, the remaining discussion identifies facilities and training ranges based on their association or physical location within either open/operational or built-up areas.

3.1.1.1 Open/Operational Areas

The open/operational areas on the West and East Reservations are used as training ranges and test ranges and comprise 68,002 acres (106 sq. mi.) or approximately 93 percent of the installation. Active and Reserve component units of all services use the training areas mainly for mountain/desert training, escape and evasion training, brigade-size field training exercises, and maneuver exercises.

The West Range is on the West Reservation, west of the cantonment area and covers approximately 16,453 acres (26 sq. mi.) of land (see Figure 3.1-4). The West Range is used for training and testing. There are no live fire training areas in this range, and at specified times the range is used for research, development and testing. The northwest corner of the West Range, known as training area Juliet, is predominantly used by the

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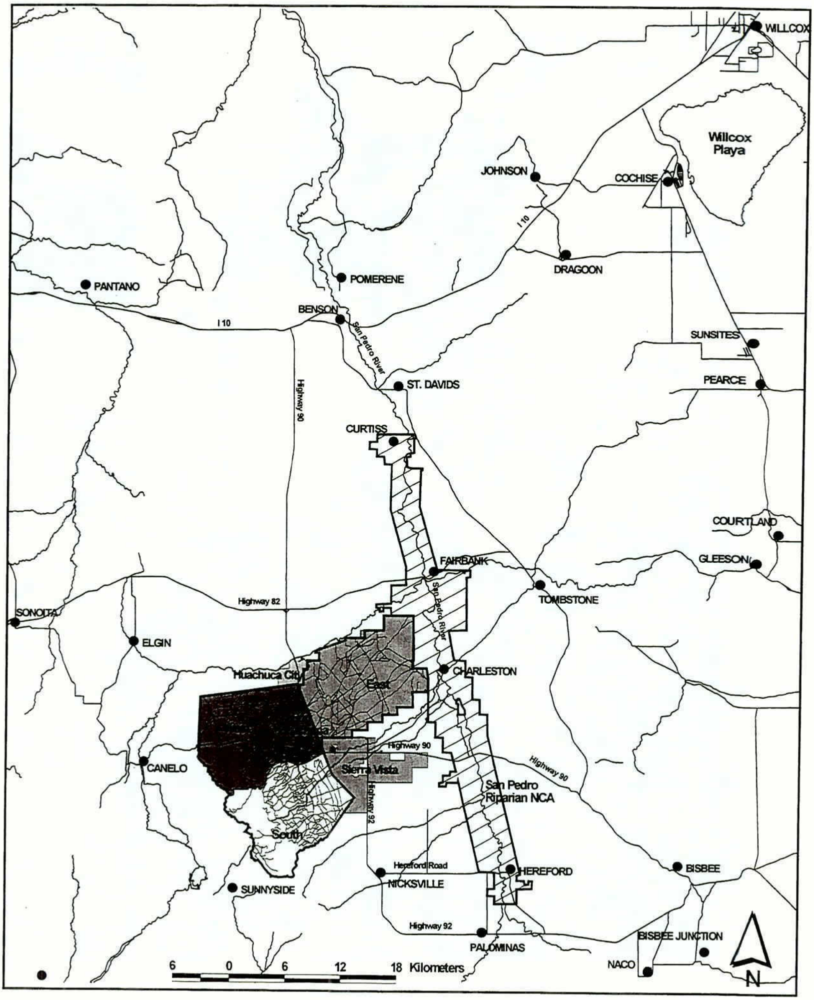

FIGURE 3.1-1

Fort Huachuca & Surrounding Areas

FIGURE 3.1-2

Land Ownership

Roads
Private
State Trust
BLM
Parks & Recreation
Coronado N.F.
Ft. Huachuca
Coronado N. Mem.

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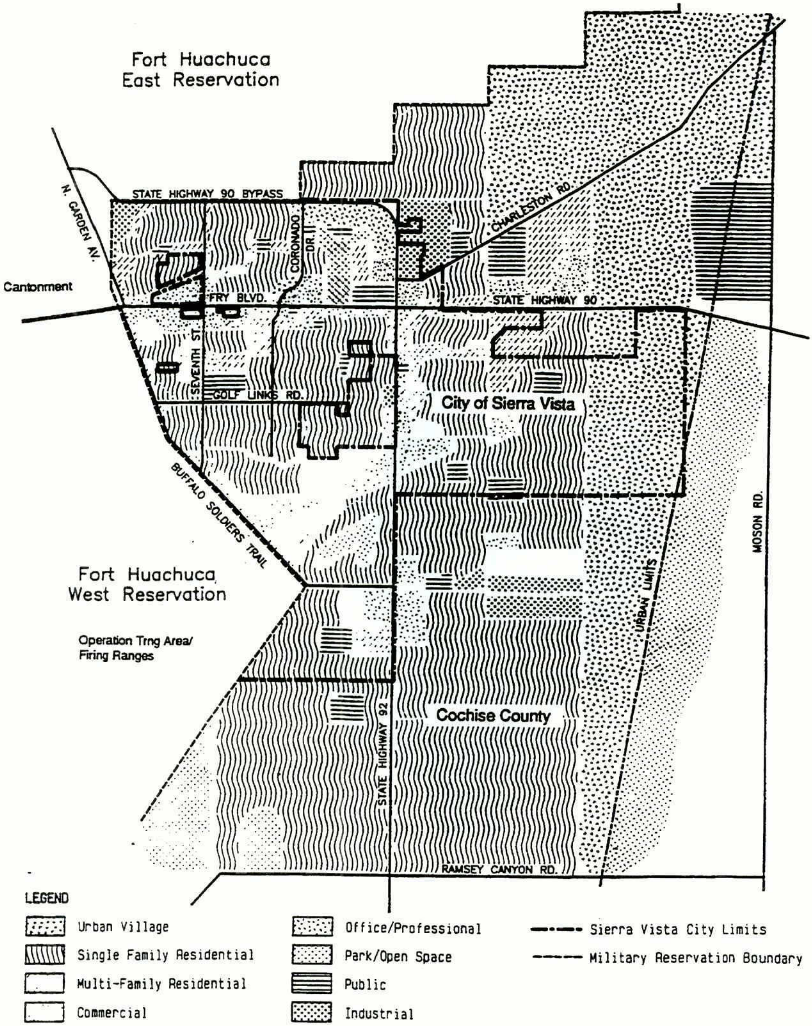

FIGURE 3.1-3 City of Sierra Vista: Land Use (Zillgens 1991a)

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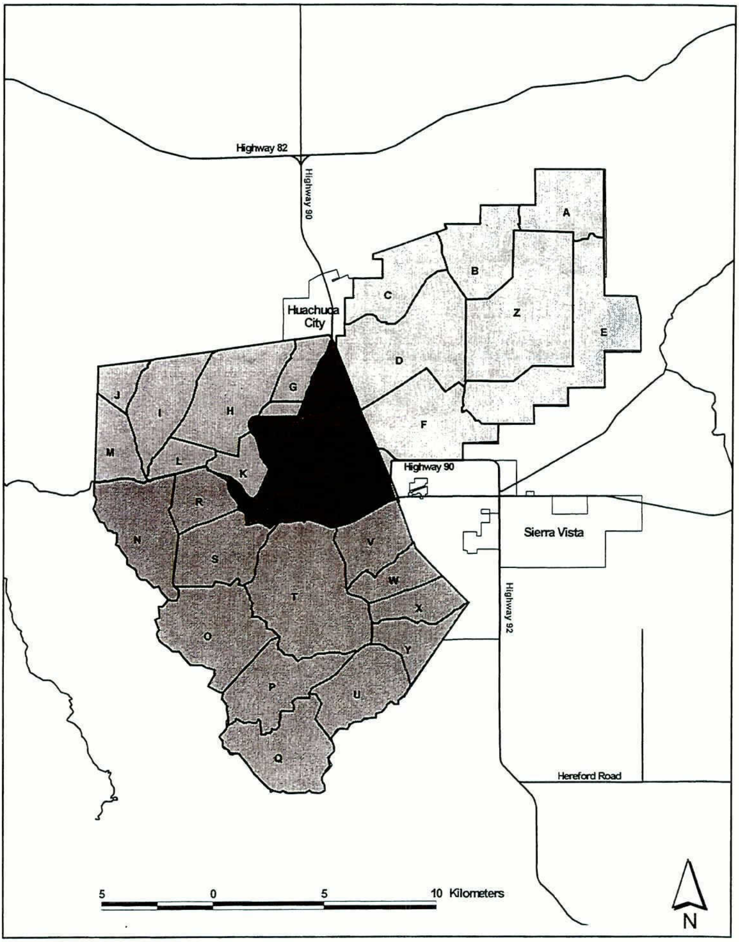

FIGURE 3.1-4

Fort Huachuca: Land Use

Buildings
Major Roads
Trainingarea-2.shp
Landuse Divisions
Built Up Area (Cantonment/Airfield)
Open/Operational Area (East Range)
Open/Operational (South Range)
Open/Operational (West Range)

Intelligence School for training of remote control pilots for UAVs. The EPG also performs some research and development testing in this area. The launching of UAVs from a supporting facility is one of the tests performed on the West Range.

The South Range is on the West Reservation located south of the built-up area and covers approximately 24,334 acres (38 sq. mi.) which includes most of the installation's extent of the Huachuca Mountains (see Figure 3.1-4). The eastern slopes of the southern portion of the mountains are used in part for impact areas from the firing positions located in the flat terrain of the eastern portion of the range. Training and some testing occur in the northern portion of the mountains. The range is divided into 12 training areas, 17 firing ranges, and several impact areas.

The East Range is on the East Reservation, east of the cantonment area and covers approximately 27,215 acres (42 sq. mi.) of land (see Figure 3.1-4). The East Range serves as a platform for research and development testing and training (see Figure 3.1-4). The area contains six training areas, a demolition range, a tactical assault landing strip, an impact area, three dropzones, and five off-road maneuvering areas. These five designated areas provide the only off-road maneuvering areas for wheeled and tracked vehicles on the East Range. Use of these five areas is controlled by the Fort Huachuca Range Control. The five areas are rotated to allow time for vegetative recovery and groundcover restoration. Area Zulu contains a 6954 acre (11 sq. mi.) impact area for various types of self propelled artillery and mortars. When live fire exercises occur, the entire East Range is closed for all other training activities. Some areas within Area Zulu may contain unexploded ordnance (UXO). Fort Huachuca Range Control dictates strict adherence to the 'off-limits' policy of this impact area and warning signs are posted in the area to alert personnel of the potential danger. Aside from hunting, outdoor recreation is not permitted on the East Range (ENRD 1997a).

3.1.1.2 Built-up Areas

The two built-up areas on the installation include the cantonment area, LAAF and other developed lands that occupy 5,270 acres (8 sq. mi.) or approximately 7 percent of the installation. Both are located on the eastern edge of the West Reservation. The two built-up areas are located more than a mile apart separated by a reserved land/buffer land use zone.

The majority of the buildings and structures on the installation are located within the cantonment area. The cantonment area provides the location for a variety of housing and community support services, as well as administrative and operational directorates and training facilities. Major command headquarters are located in the cantonment area as well as maintenance and storage facilities, facilities for research, development and testing, medical care, and training. Within the cantonment and other built-up areas, land management activities and maintenance fall under the direction of the Directorate of Installation Support, Fort Huachuca (DIS). The DIS is responsible for ensuring that all parts of the installation are in compliance with environmental laws and regulations. More than 2,000 buildings are located within the cantonment area.

LAAF consists of a 12,000 foot (3,600 m) Class 'B' main runway on an east-west axis, a 5,365 foot (1610 m) secondary runway on a southeast-northwest axis, and a 4,300 foot (1290 m) tertiary runway running parallel to the main runway. Support facilities including a flight control tower, a navigational aids building, an airfield operations building, and an airfield fire and rescue station. Storage buildings are located along the southern side of the main runway and within the operational land use zone. Maintenance facilities and the City of Sierra Vista air terminal are on the north side of the airfield (Zillgens 1991a).

3.1.2 Operational Activities at Fort Huachuca

Fort Huachuca is one of 16 U.S. Army installations under the management of the U.S. Army Training and Doctrine Command (TRADOC). It is the Headquarters for the U.S. Army Intelligence Center (USAIC) and the U.S. Army Signal Command (USASC). The Garrison Commander and principal training staff are integrated into the USAIC Headquarters Command, designated as USAIC&FH. Major missions assigned to the installation exist to:

- research, develop, test, and evaluate concepts, doctrine, materials, and equipment in the areas of intelligence, electronic warfare, and information systems;
- develop, conduct, and evaluate training in intelligence, electronic warfare, and information systems;
- provide trained operational forces in the areas of intelligence and communications;
- perform aviation operations; and
- provide training opportunities for active duty, Reserve, and National Guard forces.

The ongoing missions and activities at Fort Huachuca constitute the operational baseline at the installation. This operational baseline at Fort Huachuca is comprised almost entirely of intelligence and communications systems testing and training. Because of the nature of this mission, these activities account for nearly 95 percent of training range use (USAIC&FH 1997). Other supported activities on the installation include field training exercises, aviation activities, live-fire qualification and training, vehicle maneuver training, and administrative and support activities.

3.1.2.1 Research, Development, Test, and Evaluation Activities

RDT&E activities include the White Sands Missile Range EPG that has a division which plans and tests electronic systems at Fort Huachuca. These test programs include the Suite of Integrated Radar Frequency Counter Measures, Suite of Integrated Infra-Red Countermeasures, Battlefield Combat Identification System, and the Unattended Ground Sensors System (Table 3.1-1). Other test programs are conducted by the Army

TEXCOM Intelligence Electronic Warfare Directorate (IEWTD) and the Joint Interoperability Test Command (JITC). These activities are continuations of current on-going test programs.

Table 3.1-1. Research, Development, Testing, And Training

Suite of Integrated Radar Frequency Countermeasures	A developmental program for improving air-borne electronic warfare capabilities of Army fixed-wing and rotary-wing aircraft. The currently programmed series of tests involve mostly static measurements of equipment mounted on a UH-60 helicopter. This series of tests will be followed by a Post Production Qualification Test series in FY98 and FY99.
Suite of Integrated Infra-Red Countermeasures	An advanced electronic warfare counter vulnerability system mounted on rotary-wing aircraft. It is also currently scheduled for testing at installations other than Fort Huachuca.
Battlefield Combat Identification System	An improved electronic identification equipment. The programmed series of initial tests will utilize the Compact Antenna Range for development of the systems antenna patterns for equipment mounted on the Abrams combat tank, and the Fire Indirect Support Team Vehicle (FISTV). Multiple small-to-medium scale tests are programmed or the East Range, and various Army Security Agency (ASA) Sites around Fort Huachuca.
Unattended Ground Sensors	This program will involve evaluating the performance of test units placed alongside established roads in the East Range. Tests will include use of various wheeled and tracked vehicles driven along the roadways.
Tactical UAV	This is currently in the conception and design phase of development. The envisioned system will use the JT-UAV (Hunter) facilities and equipment, but at a reduced scale. The proposed equipment baseline set for the T-UAV would consist of 4 air vehicles, with support equipment consisting of only 2 High Mobility Multipurpose Wheeled Vehicles with trailers. A total of 4 personnel are projected for operation of each baseline set of equipment. T-UAV would be operated by the Army and Marine Corps (PSL 1994c).

3.1.2.2 Training Activities

Most training programs at Fort Huachuca are conducted at the modernized US Army Intelligence Center (USAIC) and School complex; and at the UAV academic area on the West Range. Mission training is conducted by various DoD and other governmental agencies and is proposed by the U.S. Army Reserve (USAR) and AZ ARNG Units (Table 3.1-2).

Table 3.1-2. Training Activities

Tactical UAV	Training and test activity on the T-UAV was projected for initiation in FY98 with 3 Army systems. A total procurement and fielding of 103 Army systems and 99 Marine Corps systems is projected through FY2005. A potential student throughput of 1,678 T-UAV trainees is projected for the Joint Services UAV Training Center for this period of time (PSL 1994c).
US Army Reserve	Proposed training and stationing of 14 full-time and 105 reservist positions and training of an additional 385 personnel at Fort Huachuca; use of large palletized load system (PLS) and heavy equipment transporter (HET) vehicles and other vehicles on the East Range at Fort Huachuca. These activities have been addressed under separate NEPA documentation for which the USAR is the proponent.
AZ Army National Guard	Proposed training of E Troop 118th Cavalry (E/118th CAV) of the AZ ARNG equipped with M1-A1 Abrams Tanks, M3 Bradley Combat Fighting Vehicles, and M106 Mortar Tracks. Contingent upon the outcome of an in-process EA, the E/118th will operate and train at Fort Huachuca using the East Range as a maneuvering range and the South Range as a tank firing range. Unit training equipment sites (UTES) will be established in the cantonment to maintain the assigned equipment inventory. These activities are being addressed under separate NEPA documentation for which the AZ ARNG is the proponent.

3.1.2.3 Administrative and Support Activities

The administrative activities performed at Fort Huachuca are those activities associated with the day-to-day operation of the installation and the ranges, inclusive of those activities performed by USAIC and Fort Huachuca, the Directorates, and partner organizations. These include routine:

- Military and civilian administrative, manpower management, legal, community, public safety, and fiscal services.
- Community relations and human affairs programs.
- Facilities planning, engineering, maintenance, and management services.
- Logistics management.
- Natural resources planning and environmental protection services.
- Health care services and facilities.

Several administrative and support organizations exist at Fort Huachuca to support the installation's ongoing role as a major Army testing and training installation. Personnel from these organizations are located in the cantonment.

3.1.2.4 Other Authorized Activities

The RPMP also supports smaller, less frequent activities of the various installation tenants and guests. These activities include the use of classroom and training facilities across the cantonment for formal instruction and training as well as urban recreation facilities including playgrounds, golf course, tennis courts, and ball fields. There are also several locations across the installation that are capable of supporting many recreational activities including hunting, bird watching, driving for pleasure, hiking, sightseeing, horseback riding, and climbing (ENRD 1997a). The RPMP does not govern the use of installation lands for these purposes, but is consistent with them. It provides for the programmed planning of installation needs such as future land use changes and construction or renovation projects to support the ongoing requirements of its tenants and personnel within the cantonment area.

3.1.3 Recreational Activities at Fort Huachuca

Recreational use of Fort Huachuca lands has increased in recent years along with the general increase in tourism throughout the Cochise County area. Fort Huachuca is an open post and areas outside the firing ranges and impact areas are available for recreational activities. The variety of natural and recreational resources in the Fort Huachuca area, especially for bird watching and hiking, suggests that interest in these resources will continue to grow. Popular activities at the Fort include bird watching, hiking, horseback riding, golfing, fishing, and hunting. Generally, recreational activities are unrestricted but portions of the Fort may be closed to the public during military training activities. Civilians participating in recreational activities can gain access to the installation by registering their vehicle at the main gate and obtaining a vehicle permit.

Public access to recreational areas may be prohibited by the Range Control officer due to ongoing training and testing activities. As a result, some or all of Fort Huachuca may be closed to recreational activities on any given day.

3.1.3.1 Hunting and Fishing

Mule deer, white-tailed deer, pronghorn, javelina, and mountain lion are historically the big game species hunted at Fort Huachuca. Hunters also have the opportunity to hunt three species of quail and two species of dove. There are 30 hunting management areas on Fort Huachuca (Figure 3.1-5). Fort Huachuca hunting seasons and bag limits are set in coordination with the Arizona Game and Fish Department (AGFD). Hunting on post is limited to active and retired military, federal civilians, and family members who have passed a hunter education course and meet other state and fort requirements. During recent years, no pronghorn hunting has been permitted on the Fort due to a decline in population numbers (Hessil 1997).

There are 16 ponds (approximately 32 acres) located on post (Table 3.1-3). Seven of these ponds are stocked with trout if water conditions are favorable. Golf Course and Gravel Pit ponds may be fished 24 hours per day, year round, with the proper permits (ENRD 1997a). Other ponds open to fishing, may be fished between 0500-2100 hours with some additional restrictions. Garden Canyon Creek is closed to fishing. (Hessil 1998a). The use of salamander as bait is prohibited by the Arizona Game and Fish Department and is not permitted on Fort Huachuca.

The number of permits issued for hunting and fishing on the Fort has decreased. Typically the Sportsmen Center at Fort Huachuca issues 1300 permits by August. In 1997 only 798 permits were issued by August (Eccles 1997). This decrease may be attributed to the drought in 1996, and thus fewer fishing permits issued (Eccles 1997).

3.1.3.2 Hiking, Camping, and Sports

There are several camping and picnicking areas on Fort Huachuca (ENRD 1997a). Figure 3.1-5 shows the location of these areas. These areas include:

- Lower Garden Canyon picnic area which has ten sites with tables and grills and is open to self-contained recreation vehicle and tent camping. The area includes a comfort station, playgrounds, and a ramada for protection from the sun and rain.
- Middle Garden Canyon picnic area which has picnic tables, grills, playgrounds, and ramadas.
- Upper Garden Canyon picnic area which has picnic tables, grills, playgrounds, and ramadas.
- Golf Course Pond which has 12 picnicking sites with tables, grills, and ramadas. RV camping is permitted and a comfort station and softball field are located on site.

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- Site Maverick which has 12 campsites with tables and grills. RV and tent camping is permitted and restroom facilities are available.
- Apache Flats Recreational Vehicle (RV) Park which has 37 spaces for RVs with electricity, picnic tables, grills, and a dump station. Water is available at 27 spaces.
- Split Rock cabin.
- Garden Canyon cabin.
- Sawmill Canyon which is open to picnicking.
- Sportsman Center campground which has 24 hookups for RVs, ramadas, picnic tables, and grills.

Garden and Huachuca Canyon areas offer a wooded site for picnicking away from the main post. Reservoir Hill offers a spectacular view of much of the San Pedro Valley. The golf course area provides a variety of recreational opportunities. Camping on post is permitted only in designated campgrounds and mountain areas are accessible only during the day.

Approximately 45 miles (72 km) of hiking trails are available on the Fort. Some of these connect with USFS trails and provide hiking access to other portions of the Huachuca Mountains including the Miller Peak Wilderness Area. There are currently three hiking trails listed by the Sportsmans Center: Blacktail Canyon, Scheelite Canyon, and Sawmill Canyon.

Recreational rock climbing and repelling is prohibited. An existing 18-hole Fort Huachuca golf course serves both military and civilian personnel and is located on the eastern end of the cantonment area just south of the Main Gate to the post. Caving is permitted during certain times of the year. This activity is restricted during times of lesser long-nosed bat roosting.

3.1.3.3 Horseback Riding and Grazing

Horses can be rented by the hour or day at the Buffalo Corral Riding Stables, located on the West Gate Road. Boarding of privately owned horses is also available. (Figure 3.1-5). Three areas are used for grazing horses at Fort Huachuca. These three areas support approximately 50 to 60 horses. Use of these areas is rotated on 12 to 18 month rotation schedules.

Pasture A is approximately 946 acres (1.5 sq. mi.) and is used from May to October on a very infrequent basis (Hessil 1998b). Pasture B is approximately 175 acres (0.3 sq. mi.) and is used between the months of March and May. Pasture C is approximately 312 acres (0.5 sq. mi.) and divided into two sections with rotation between the two. Horses are grazed in Area C from May to October (Hessil 1998b). At other times, horses are kept in the corral are not grazed.

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Horseback riding is authorized across the installation with the exception of firing ranges (when in use) and impact areas.

Table 3.1-3 Ponds of Fort Huachuca

Pond	Game Management Area	Size (Acres)	Depth	Stocked[1]
Golf Course	V	5	>14'	Yes
Officers Club	Cantonment	3	>15'	Yes
Gravel Pit	T-2	5	>13'	Yes
Woodcutters	T-3	2.5	>15'	Yes
Fly	T-1	3.25	5'	Yes
Lower Garden	Y	2.5	8'	No
Middle Garden	U	2	8'	No
Sycamore I	H	2.5	15'	Yes
Sycamore II	J	1.75	7'	Yes
Tinker Canyon	U	1	8'	No
Blacktail	N-2	1.5	–	No
Hidden	I	0.75	2.5'	No
Antelope	I	1.5	2'	No
Laundry Ridge	K	–	–	No
Upper Garden	Q	–	–	No
Kino	M	–	–	No

[1] Ponds are stocked with trout if conditions are favorable but not always annually.

3.1.4 Ongoing Conservation Measures

The Army has incorporated many conservation measures into its baseline operations at Fort Huachuca in order to reduce environmental impacts and improve training conditions. These conservation activities include efforts to reduce erosion across the installation, protect threatened and endangered (T&E) species on the Installation, water conservation and effluent reuse and recharge.

3.1.4.1 Erosion Control

Several actions have been taken by Fort Huachuca to identify, monitor and improve watershed conditions across the Installation. These activities include mesquite root-plowing and upland revegetation, installation of erosion impoundment structures, implementation of new land management guidelines, modification of range use and training routines, and consultation with other Federal agencies in the development of erosion reduction and groundcover restoration plans and practices. Several of these actions by Fort Huachuca have been directed under the Army's Integrated Training Area Management (ITAM) program and have led to an overall increase in watershed quality throughout the Army's ownership of the land.

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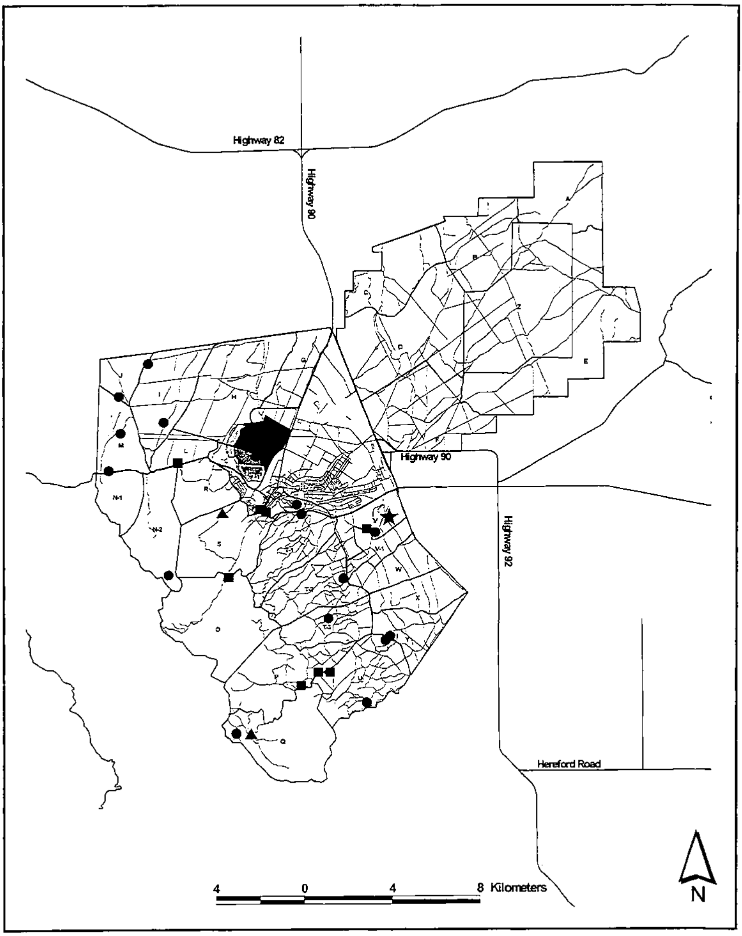

FIGURE 3.1-5

Fort Huachuca: Recreational Activities

Game Managament Areas
Cabin
Pond
Picnic Area
Golf Course
Roads

Buffalo Corral
A
B
C1
C2

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An East Range watershed improvement plan (ENRD 1997b) has been developed by Fort Huachuca identifying watershed improvement strategies and best management plans such as check dams, revegetation and reseeding actions to retard erosion on the East Range of the installation.

Other erosion control measures being employed on the training ranges include scheduling training during the driest seasons (April through June) and allowing sufficient time for soils to dry after heavy rains before resuming training.

3.1.4.2 Actions Taken to Protect Threatened and Endangered Species

Actions taken to protect federally-listed species include, but are not necessarily limited to the following:

- Live fire suspended indefinitely on Range 1 (machine gun range).
- Night fire prohibited on Ranges 2 (Zero Range), 3 (multipurpose small arms), 4 (Pistol qualification) annually from June through September.
- Pyrotechnics prohibited in any area designated as a major agave stand.
- Night training prohibited in any area designated as a major agave stand June through September.
- Wheeled vehicles prohibited from leaving established roadways in any area designated as a major agave stand.
- Track vehicles prohibited from entering an area designated as a major agave stand.
- Fire suppression plan required prior to approval of authorized training in any area designated as a major agave stand.
- "Maneuver boxes" established for all tracked vehicle off-road maneuvering on the East Range.
- Track vehicle maneuvering permanently suspended on the South Range. If the AZ ARNG EA is approved for tank and Bradley gunnery, vehicles will only be permitted on the tank trails to and from the range and while on the range, only in the maintenance area or the firing trail.

3.1.4.3 Water Conservation and Recharge

Fort Huachuca adopted and implemented an irrigation conservation plan in March of 1994 that saves approximately 800 ac-ft of water per year and will save and/or reuse as much as 1,000 ac-ft per year by 2025. Conservation measures include: education and training (Water Wise), reduced watering scheme, use of waterless urinals, rooftop collection systems, closure/demolition of WWII-era buildings, installation of low-flow water fixtures in all construction, retrofitting older buildings and residences with low-flow fixtures, conversion of high consumption landscaping with xeriscaping (desert landscaping), and an aggressive leak detection program.

Due to conservation efforts at the installation, total well production decreased to 2,355 and 2,357 ac-ft in 1996 and 1997 respectively. This was 8 percent less than was pumped in 1994 and 27 percent less than in 1989 (ENRD 1997c) and represents a substantial savings of water (69 million gallons/year and 278 million gallons/year respectively). In recognition of its water conservation efforts, Fort Huachuca received the FY94

Federal Water Conservation Award from the U.S. Army Office of Environment, Occupational Health and Safety.

To increase groundwater recharge into the local aquifers from mountain front recharge, Fort Huachuca has just completed a preliminary study to analyze the potential of increasing infiltration within the installation's major watersheds and to design methods of increasing groundwater recharge into the local aquifers. The study identified locations and recharge practices, both from an engineering and non-engineering perspective. The first site specific infiltration test has just been completed and designs for a pilot projects are underway. The overall recharge goal is over 1,000 ac-ft of water per year.

3.1.4.4 Effluent Reuse and Recharge

Fort Huachuca has been using treated effluent to water the golf course and a large parade field for nearly three decades. Currently, approximately 40 percent of the installation's annual 1300 ac-ft of treated effluent is being used for landscape maintenance at areas including the golf course, Chaffee Parade Field, and the Outdoor Sports Complex. Fort Huachuca is now exploring the possibility, subject to funding, to reuse or recharge all of the effluent generated on the installation. Future plans indicate that 86 percent of the installation's landscape requirements could be met by expanding the existing treated effluent distribution system. A 19 percent, or 460.3 ac-ft, reduction in the installation's annual groundwater demands would result from this effort. Recent geophysical investigations indicate that a significant recharge component exists beneath the current treated effluent ponds. Efforts are underway to better characterize this recharge

3.2 SOCIOECONOMICS

The primary socioeconomic regions of influence potentially affected by the proposed action at Fort Huachuca includes Cochise County and the communities of Sierra Vista and Huachuca City (the closest and most integrally linked communities to the installation). To a lesser degree, activities at Fort Huachuca affect the economy of the state through military-related expenditures made outside the Cochise County region.

The socioeconomic resources of the potentially affected region are characterized in terms of population and housing, economic activity, public services, and infrastructure. Because these resources would be interrelated in their response to the proposed action at Fort Huachuca, their current condition is assessed in order to provide a basis for analyzing potential socioeconomic impacts. A change in employment, for example, may lead to population movements into or out of a region and, in turn, lead to changes in demand for housing and public services. The baseline conditions established in this section were compiled from federal, state, county, and installation sources.

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3.2.1 Population

The current population in the county accounts for less than 3 percent of the state population of approximately 4 million persons. Between 1980 and 1990, the county population increased 13.9 percent. Between 1990 and 1995, the county population increased 12.7 percent. City and county demographics are shown in Table 3.2-1.

Table 3.2-1. City and County Demographics

	Huachuca City	Sierra Vista*	Cochise County
1997 Population	1,985	36,915	116,725
1995 Population	1,978	36,622	110,062
1990 Population	1,782	32,983	97,624
1980 Population	1,661	24,937	85,686
1990 Households	680	11,672	34,546
1990 Avg. Household Size	2.62	2.83	2.83

Source: U.S. Bureau of the Census 1982, 1992, 1996, 1997
* Includes Fort Huachuca residents

Sierra Vista's population, including Fort Huachuca, was estimated to be 36,915 in 1997 and represents 31.6 percent of Cochise County's population (Arizona Department of Economic Security [ADES] 1997). The city's population grew by 10.9 percent from 1990 to 1997, while the county's population increased (19.6 percent) during the same period (U.S. Bureau of Census 1997). Cochise County's 1997 population is estimated at 116,725, which represents only 2.5 percent of Arizona's population.

Two measures of Fort Huachuca population are the Fort Huachuca employee population and the noonday population. The employee population includes all military, civilian, and contractor personnel employed on the fort (Table 3.2-2). The Fort Huachuca noonday population includes assigned military personnel, their family members living on post, and all civilians employed on post (Table 3.2-3). Input to the noonday population comes from several different databases and is not corrected for double counting. For example, family members who are employed on post are counted twice. Although there are an additional 12,390 retired military and family members residing in the region, these are in the area by their own choice, and may not have retired from Fort Huachuca. The total Fort Huachuca employee population, not including retirees and their families, represents about 15 percent of Cochise County total population.

3.2.2 Housing

According to the 1990 Census (U.S. Bureau of the Census 1994), almost one-third of the housing in the county is located in Sierra Vista (32.1 percent). Housing vacancy rates ranged from a 9.7 percent in Sierra Vista to 18.8 percent in Huachuca City, with an overall county vacancy rate of 14.1 percent. The median value of housing units in 1990 was below the statewide median value of $80,100. An estimated 64 percent of the occupied units were owner-occupied, while the remaining 36 percent were renter-occupied. Of the 5,692 vacant units, 1,059 comprised recreation homes, seasonal homes, and other housing classifications. City and county housing statistics are shown in Table 3.2-4.

Table 3.2-2. Fort Huachuca Employee Population

	September 1994	September 1995	September 1996	September 1997
Military Assigned	*7,533*	*5,854*	*5,670*	*5,703*
Living On Post	4,280	4,104	3,629	3,026
Living Off Post	3,253	1,750	2,041	2,677
Military Family Members	*11,894*	*11,469*	*11,258*	*10,690*
Living On Post	5,108	4,978	5,027	4,734
Living Off Post	6,785	6,491	6,231	5,956
Military and Family Members	*19,427*	*17,323*	*16,928*	*16,393*
Living On Post	9,388	9,082	8,656	7,760
Living Off Post	10,038	8,241	8,272	8,633

Source: DRM 1997

1. This figures represents non-DoD civilian workers on Fort Huachuca.

This figure is calculated based on U.S. Census average household size for Cochise County, assuming one civilian employee per household. The civilian population may be overstated.

Seventy percent of the military personnel assigned to Fort Huachuca reside on post. There are 1,952 family housing units located on post or leased off-post (Directorate of Resource Management [DRM] 1997). In addition to these quarters, there are 236 transient quarters and 3,727 troop billeting spaces. Army Guard and Reserve members, who typically train at Fort Huachuca one weekend per month and for a two-week period in the summer, are housed in existing barracks on post during their training.

Of the military personnel assigned to Fort Huachuca who reside off post, approximately one-fourth own a home or mobile home, another fourth rent a home or mobile home, and the remaining half rent an apartment. Military personnel own 15 percent and rent 14 percent of the single family homes in Sierra Vista, own five percent and rent three percent of the mobile homes, and rent 58 percent of the apartments.

Table 3.2-3. Fort Huachuca Noonday Population

	September 1994	September 1995	September 1996	September 1997
Military Assigned	7,533	5,854	5,670	5,703
DoD Civilian Employees	2,937	2,845	2,675	2,466
Other Civilian Employees[1]	2,842	2,165	1,938	1,947
Total Employees	**13,312**	**10,864**	**10,283**	**10,116**
Military Family Members Residing On Post	5,108	4,978	5,027	4,734
Total Noonday Population	**18,420**	**15,842**	**15,310**	**14,850**

Source: DRM 1997

1. Represents non-DoD civilian workers on Fort Huachuca. Note: The noonday population includes assigned military, their family members living on post, and all civilians employed on post.

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Table 3.2-4. City and County Housing, 1990

	Huachuca City	Sierra Vista	Cochise County
Total Housing Units[1]	837	12,927	40,238
Occupied Units	680	11,672	34,546
Occupancy Rate (percent)	81.2	90.3	85.9
Owner-occupied Units	400	5,366	21,983
Occupancy Rate (percent)	58.8	46.0	61.6
Renter-occupied Units	280	6,306	12,563
Occupancy Rate (percent)	41.2	64.0	38.4
Median Value	$47,000	$78,100	$60,600
Median Rent	$250	$350	$287

Source: U.S. Bureau of the Census 1994.

[1.] Includes housing units such as recreational homes, migrant worker quarters, and other not designated either owner-occupied or rental units.

3.2.3 Economic Activity

In 1997, nearly 10,116 workers, both civilian and military were employed at the Fort and accounted for approximately one-fourth of all County employment (Nakata 1997c). The 1995 per capita income in the county was $15,312.00 which was 32 percent less than Arizona's per capita income (US Department of Commerce 1997). The 1996 unemployment rate for the county was 8.8 percent which was larger than both the Sierra Vista (6.8 percent) and Arizona (5.1 percent) unemployment rates (ADES 1997). In 1995, the largest sector of the County's economy was government, including federal, state and local (34.7 percent), followed by services (22 percent) and retail (21 percent) (US Department of Labor 1997).

As a major employer and consumer, Fort Huachuca plays a major role in the economic well-being of Southern Arizona. With 10,116 military and civilian employees in southern Arizona, post commands and activities account for approximately one-fourth of all employment in Cochise County. Through the years, the dynamic relationship between the post and the communities of Cochise County has changed from one of dependence by the community to one of interdependence between the post and the community

Tourism plays an important part of Cochise County's economy with an estimated 3.5 million visitors per year (Young Nicholas Gilstrap 1997). National parks and forests, including Fort Bowie, the Coronado Memorial, and the Chiricahua National Monument as well as state parks attract many visitors each year. It is estimated that the average tourist during a multiple-day stay in Arizona spends an average of $111.00 per day (U.S. Travel Data Center 1996). The peak tourist season within the county is from Christmas until Easter. There are 2,372 hotel, motel, and bed & breakfast (B&B) rooms within the County as well as 2,229 RV spaces located in private parks within the county. In addition to these spaces, there are 253 campsites located in state and federal park lands and forests within the county that allow RV camping with certain restrictions on the size of the vehicle (Cochise County 1997).

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Ramsey Canyon and the SPRNCA attract many visitors to the Sierra Vista region. It is estimated that nature-based tourism contributes nearly $3 million to the Sierra Vista economy each year. Sierra Vista has 872 hotel, motel, or B&B rooms as well as 27 RV parking spaces.

3.2.3.1 Employment

Concurrent with population increases, employment in the region has experienced a moderate amount of increase relative to other small urban communities in Arizona. Based on information from the Bureau of Economic Analysis (BEA), the total number of jobs in Cochise County increased about 23 percent during the last 13 years. The unemployment rate of about 7 percent experienced in Cochise County, while higher than the state unemployment level of 5.7 percent, is lower than that encountered in many predominantly rural regions (U.S. Bureau of the Census 1994). Cochise County employment information is contained in Table 3.2-5.

Government and government enterprises account for the greatest county employment (38 percent of total positions). Employment in the services industry represents 22 percent of the total and the retail trade industry employs about 17 percent. It is important to note that Fort Huachuca employment figures may not be consistent with federal military and federal civilian employment reported in state and federal statistics due to differences in reporting practices (e.g., accounting for employment by place of residence versus place of work).

3.2.3.2 Fort Huachuca Employment

Personnel associated with Fort Huachuca commands and activities totaled 10,116 workers in FY97 (DRM 1997). Based on economic multipliers from the Economic Impact Forecast System developed by the U.S. Army Corps of Engineers' Construction Engineering Research Laboratory (CERL), it is estimated that Fort Huachuca supports approximately 40,000 jobs in Arizona and approximately 18,000 jobs in Cochise County. These jobs represent the direct and secondary employment generated by Fort Huachuca personnel and expenditures.

The projected authorized strength at Fort Huachuca changes semi-annually with the issuing of the ASIP. The projections for changes in authorized strength at Fort Huachuca are shown in Table 3.2-6. The five-year trend indicates a steady decline in projected personnel assigned to various units at the installation. The decline in personnel numbers is primarily a result of reduced authorizations due to budget and mission changes.

As a result of dynamics such as civilian personnel hiring practices, needs of the Army in priority missions, downsizing, and budget constraints, not all authorized positions are filled at any given time. A comparison of authorized strength and actual employment is shown in Table 3.2-7. Historically at Fort Huachuca, the actual number of employees has been less than the authorized strength.

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Table 3.2-5. Cochise County Employment By Industry, 1993

Industry	Number Employed
Agriculture, Forestry and Fisheries	1,889
Mining	119
Construction	1,786
Manufacturing	1,480
Transportation and Public Utilities	1,815
Wholesale Trade	896
Retail Trade	7,137
Finance, Insurance and Real Estate	1,640
Services	9,094
Federal Civilian	4,543
Federal Military	6,088
State and Local Government	5,357
TOTAL	**41,844**

Source: Bureau of Economic Analysis 1995.
Note: Employment is reported by place of work and does not necessarily coincide with the number of workers residing in a specific county.

Table 3.2-6. Changes In Projected Authorized Strength For Fort Huachuca

	ASIP Nov. 1992	ASIP Nov. 1993	ASIP Nov. 1994	ASIP Nov. 1995	ASIP May 1996
FY 1995	14,172	14,164	13,854	N/A	12,647 (FY96)
FY 1998	14,839	14,415	13,835	12,942	12,309
FY 2000	N/A	14,415	13,825	13,186	11,844
FY 2002	N/A	N/A	N/A	N/A	11,941

Source: DRM 1992, 1993, 1994, 1995, 1996, 1997

3.2.3.3 Income and Expenditures

Earnings in the county totaled approximately $954 million in 1993 (BEA 1995). The distribution of earnings across industries is essentially the same as the distribution of employment, with government and government enterprises, services, and retail trade representing the largest income producers (BEA 1995).

Table 3.2-7. Comparison of Projected Authorized Strength and Actual Employment

	ASIP 1993	Actual 1993	Percent[1]	ASIP 1995	Actual 1995	Percent
Military	6,951	5,823	83.8	7,382	5,854	79.3
U.S. Civilians	3,255	2,935	90.2	2,733	2,845	104.0
Contractors	3,661	2,495	68.2	3,739	2,165	57.9
TOTAL	**13,867**	**11,253**	**81.2**	**13,854**	**10,864**	**78.3**

Source: DRM 1993, 1995
[1]The percent column indicates the percentage of authorized positions actually filled on the installation as of September 30th of the fiscal year.

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According to the 1990 Census (BEA 1995), median household income in Cochise County was $22,425, compared to the state median household income of $27,540. Per capita income in the county was $10,716, which is 20 percent lower than the state average of $13,461. Average earnings per job in the county amounted to $22,797 in 1993, compared to the state average of $24,420 (BEA 1995).

In FY97, total payrolls associated with the military and DoD civilian personnel amounted to $276.9 million. Other expenditures in Arizona during FY97 included $243.5 million for the purchase of goods and services, and $4.4 million in other expenditures which includes $3.25 million in impact funds to Arizona school districts for military and DoD civilian children attending schools in the area, $0.9 million for damage claims processed through the Office of the Staff Judge Advocate, and $0.25 million for Army Emergency Relief grants and loans. Fort Huachuca 1997 expenditures in Arizona are shown in Table 3.2-8.

Table 3.2-8. Fort Huachuca Expenditures In Arizona, FY97

	Dollars (in millions)
Military Payrolls	$147.0
Civilian Payrolls	129.9
Purchases	243.5
Other	4.4
TOTAL	**$524.8**

Source: Directorate of Resource Management 1997.

3.2.4 Public Services and Infrastructure

Emergency services for Sierra Vista are provided by the city's fire department with 4 ambulances, 20 emergency technicians, and 2 to 3 paramedics on every crew (Lucas 1997). If needed, the city can call upon assistance from the Fry, Whetstone, and Palominas Fire Districts as well as from Huachuca City's fire departments that together maintain 7 ambulances, 48 emergency technicians, and 18 paramedics. Fort Huachuca is also available to assist Sierra Vista in emergencies with 2 ambulances and 40 emergency technicians. The Fort also has a helicopter for medivac services if needed. The Red Cross has local offices in both Sierra Vista and on Fort Huachuca. The Sierra Vista office has capabilities to assist about 100 persons in the event of an emergency and can call on the Red Cross office in Tucson for additional assistance. The Fort Huachuca Red Cross could assist 2000 persons in an emergency with tents, cots, and meals ready to eat provided by the army (Red Cross 1997).

Cochise County is served by five hospitals with a total of 233 hospital beds. The hospitals are located in Sierra Vista, Bisbee, Wilcox, Douglas, and Benson. All of the hospitals have capabilities for helicopter landings and medivac capabilities. None of the hospitals have burn units, but burn victims can be air lifted to St. Mary's Hospital in Tucson. The Sierra Vista Community Hospital has 88 beds of which 7 beds are acute and 4 are critical emergency rooms beds. The hospital has a helicopter pad and helicopter located on site.

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Patients are usually air lifted to one of three hospitals in Tucson, Tucson Medical Center, University Medical Center, or St. Mary's Hospital, which are all about 12 minutes away by air transport.

Emergency 911 calls are directed to the Fort Huachuca Fire Department. That fire department maintains two ambulances which are used to transfer victims with acute injuries to the Fort Huachuca Super Clinic to be treated or stabilized or to Sierra Vista Community Hospital for treatment. All urgent care victims are taken from the installation to Sierra Vista Community Hospital for treatment (Lucas 1997).

There are eight public elementary schools (two military), three junior high schools (one military), and one high school in the Fort Huachuca area. Higher education is provided by a number of academic institutions. More than 2,700 students attend the local branch of Cochise College. Chapman College and Golden Gate University offer extension courses. The University of Arizona Sierra Vista Campus offers upper-division and graduate courses.

As of FY97 there were 1,705 children residing on Fort Huachuca who attend schools on the installation or in neighboring communities (DRM 1997). Kindergarten through eighth grade children attend Fort Huachuca Accommodation Schools, which are jointly operation by the State of Arizona and the U.S. Department of Education. Most of the 246 children who reside on post and attend public schools in Sierra Vista attend the high school. In addition, there are 962 students whose parents are military personnel living off post and 1,510 students whose parents are DoD civilian employees. There are a total of 4,233 Fort Huachuca-related students attending schools in Cochise County, representing approximately one-third of county school enrollments. Federal impact funds amounting to $3.27 million were distributed to operate schools attended by family members of Fort Huachuca's military and DoD civilian personnel during school year 1996-1997.

3.2.5 Environmental Justice

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations, directs federal agencies to identify and address, as appropriate disproportionately high and adverse human health or environmental impacts of their program, policies, and activities on minority or low income populations in the surrounding community.

The ethnic diversity within Cochise County is comprised of 5.2 percent African American, 2.3 percent Asian , 0.8 percent Native American, 10 percent other, and the remaining 81.7 percent as unspecified white/Caucasian. Approximately 29.1 percent of the population distributed among the various race identifiers are of Hispanic origin. The ethnic diversity within the City of Sierra Vista population is comprised of 11.8 percent Hispanic, 11.5 percent African American, 4.9 percent Asian, 0.6 percent Native American, 0.2 percent other, and the remainder as unspecified white/Caucasian (U.S. Bureau of the Census 1994).

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3.3 CULTURAL RESOURCES

This section presents the existing conditions that can be found in the primary region of influence relating to cultural resources. Cultural resources include archeological and historical resources within the area. This baseline information will be used as a point of comparison when evaluating cultural resource impacts that may be caused by the proposed action and alternatives discussed in this EIS.

For the purposes of this document, the term "cultural resources" is defined as: historic properties as defined in the National Historic Preservation Act (36 CFR 64), cultural items as defined in the Native American Graves Protection and Repatriation Act (NAGPRA), archeological resources as defined in the Archeological Resources Protection Act (ARPA), sacred sites as defined by Executive Order 13007 to which access is afforded under the American Indian Religious Freedom Act, collections and associated records as defined in 36 CFR 79.

3.3.1 Background

Fort Huachuca holds a prominent position in the cultural history of the southwestern United States. Cultural resources within and near the installation boundaries encompass sites spanning approximately 12,000 years, from the Paleoindian Period to the present. In addition to the prehistoric and protohistoric cultures listed for the Middle San Pedro Valley, Fort Huachuca holds special historic significance for the Apache, Apache Scouts, and African American "buffalo soldiers." Many cultural sites at Fort Huachuca have high scientific value and provide excellent opportunities for public education and interpretation.

The San Pedro River Valley shows evidence of long-term prehistoric human activity and occupation, beginning during the Paleoindian Period. The archaeological record of the area also reflects the clash between the Apache and the Sobaipuri and the Spanish that resulted in the expulsion of the latter two groups from the San Pedro Valley in the late 18th Century. Fort Huachuca itself was established in 1877 as one of a series of military posts designed to control and defeat the Apache in the last chapter of their centuries-long competition with established Native American communities and with succeeding waves of settlers of European descent (Statistical Research 1995).

Throughout the period of Apache conflict and for several decades thereafter, Apache Scouts were based at Fort Huachuca. After 1922 and until the formal disbanding of the last Apache Scout unit in 1947, Fort Huachuca was the only home for these units (Statistical Research 1995).

During the early 20th Century, Fort Huachuca played an important role with respect to the U.S. military response to the Mexican Revolution and as the home of African American infantry and cavalry units ("buffalo soldiers"). During World War II, the installation served as the training facility for the Blue Helmet and Buffalo Divisions, both African American divisions built on the existing "buffalo soldier" units at Fort Huachuca.

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3.3.2 Archaeological Sites and Distribution

Prehistoric archaeological sites on Fort Huachuca tend to be associated with the larger drainages in the northern and eastern portions of the installation. Historic sites tend to be clustered within the developed area of the cantonment or associated with old ranching homesteads on the East Reservation. Three hundred and seventeen recorded cultural sites are located within the installation boundaries (Statistical Research 1995).

As of 1993, approximately 40,450 acres (63 sq. mi.) or 59 percent of the installation had been surveyed for archaeological sites, leaving more than 32,000 acres (50 sq. mi.) (mostly within the canyons and slopes of the Huachuca Mountains or on the East Reservation) unsurveyed (Statistical Research 1995). Figure 3.3-1 shows the surveyed areas. Three prehistoric sites in Garden Canyon, and the old post area of the cantonment have been entered into the National Register of Historic Places. Of the remaining archaeological sites identified, 7 have been evaluated as eligible for listing on the National Register, 227 are classified as potentially eligible for listing, 29 have been deemed ineligible for listing, and the significance of 75 sites has not been determined as of yet (Nakata 1997b).

The Old Fort area includes more than 50 contributing buildings dating from the 1880's to the period just after World War I (Figure 3.3-2). Excavations at the Garden Canyon Village Site have established evidence of permanent occupation dating at least to 600 A.D. during the Early Formative Period (Murray 1996). The two pictograph sites have both prehistoric drawings and protohistoric or historic Apache drawings.

Numerous other sites at Fort Huachuca, both prehistoric and historic, are considered "eligible" or "potentially eligible" for listing in the National Register of Historic Places (Statistical Research 1995). Evaluation and listing of sites will be a long-term effort, given the large number of sites and limited resources (Murray 1996). Cultural resource sites on Fort Huachuca are generally better protected and in better condition than nearby sites off the installation.

3.3.3 Protection and Monitoring of Sites

Unless otherwise indicated, the information in this and the following two sections came from the draft Cultural Resources Management Plan (CRMP) for Fort Huachuca Military Reservation (Statistical Research 1995) and an interview with John Murray, Post Archaeologist (Murray 1996) in December 1996.

Fort Huachuca faces a number of significant ongoing challenges in its efforts to monitor, protect, and, where appropriate, restore cultural sites. As an active military facility, a large number of operational activities (training, maneuver, equipment testing, live fire, and facilities management) can potentially disturb cultural resources. Since most of the installation is also open to public recreational use, the general public also presents some potential for alteration of sites. Additionally, natural events such as flooding, silt deposition, erosion, and wildfire can also damage cultural resources. Finally, particularly with respect to the pictograph sites and historic buildings, ongoing weathering and gradual deterioration must be addressed.

In order to address each of these potential problems as effectively as possible, Fort Huachuca has implemented a number of activities and programs. The first level of protection includes specific physical measures focused on major impacts (erosion control structures at the Garden Canyon Village Site, fencing to restrict access to the pictograph sites, fire suppression systems in vulnerable historic structures).

The second level of protection involves operational and procedural changes designed to prevent alteration of sites (training for personnel, designating sites near maneuver or bivouac areas as "chemically contaminated zones" or "minefields" during field exercises, prohibition of civilian off-road vehicle use away from established roads).

The third level of protection is site monitoring, conducted by the Post Archaeologist and volunteers, and ranging from almost daily at the most visible and vulnerable sites to a small annual sampling of minor, relatively inaccessible sites.

The fourth level of protection, applied to any construction or redevelopment project, requires a pre-construction surface survey of the construction site, plus ongoing monitoring of the project once underway. All contractors are required to immediately cease activity and call in the Post Archaeologist if any evidence of cultural sites is uncovered during construction.

Fort Huachuca also has an active program for evaluating and restoring historic structures. Recent activities in this program include assessments of the integrity of the adobe structures and chimneys in the "Old Post" area, evaluation and repair of windows in the same area, and restoration of several deteriorated adobe structures dating to the 1880's and 1890's. Much additional repair and restoration work must still be completed to stabilize all of the buildings in the landmark district. DoD Legacy Grant funding has been a major source of funds for both restoration and planning efforts on post, including the development of an integrated CRMP (DA 1995).

3.3.4 Research, Excavation, and Interpretation

Depending on available resources, one or more significant research projects and/or excavations are generally ongoing at any given time. At present, a small portion of the Garden Canyon Village Site is being excavated. Additionally, an evaluation of sites related to Apache Scout encampments has recently been completed (Statistical Research 1995). In preparation for a consultation with Native American communities under NAGPRA, an evaluation of artifacts recovered from excavations at the Garden Canyon Village Site has also recently been done (Statistical Research 1995). Within the landmark district, a small museum and gift shop provide interpretive services and information related to the history of Fort Huachuca and related subjects (e.g., "buffalo soldiers"). A second museum, to be housed in the old magazine building in the historic district, is now in the planning stages, with an opening date at least two years away. This museum will focus on interpretation of prehistoric human activity, as well as the Apache Scouts. The building is now undergoing

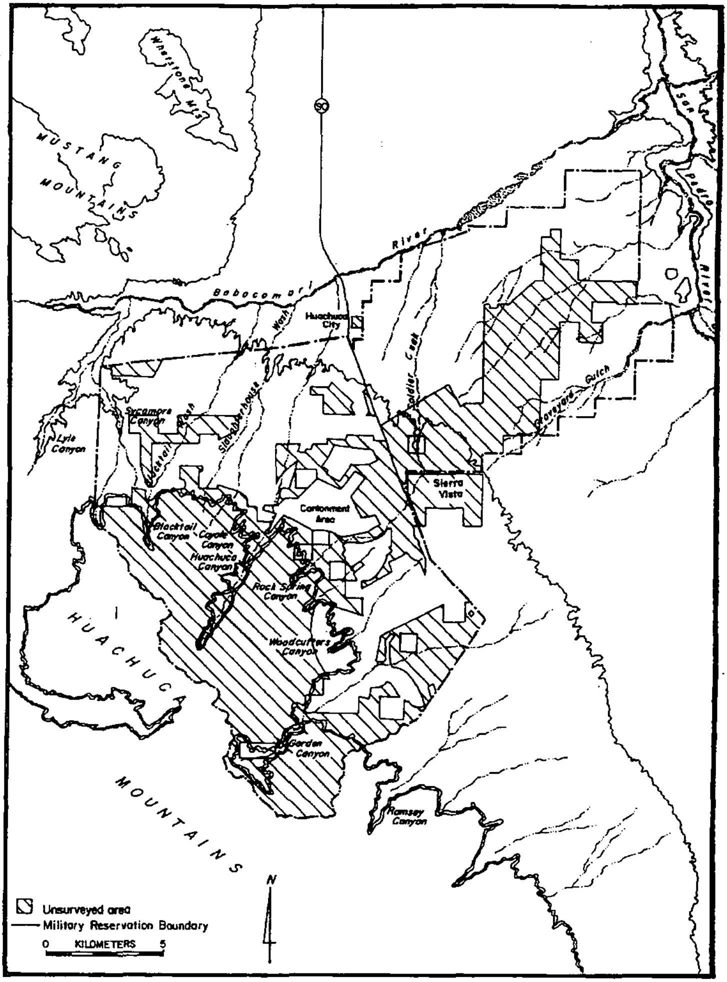

FIGURE 3.3-1 Surveyed Area of Fort Huachuca (Statistical Research 1995)

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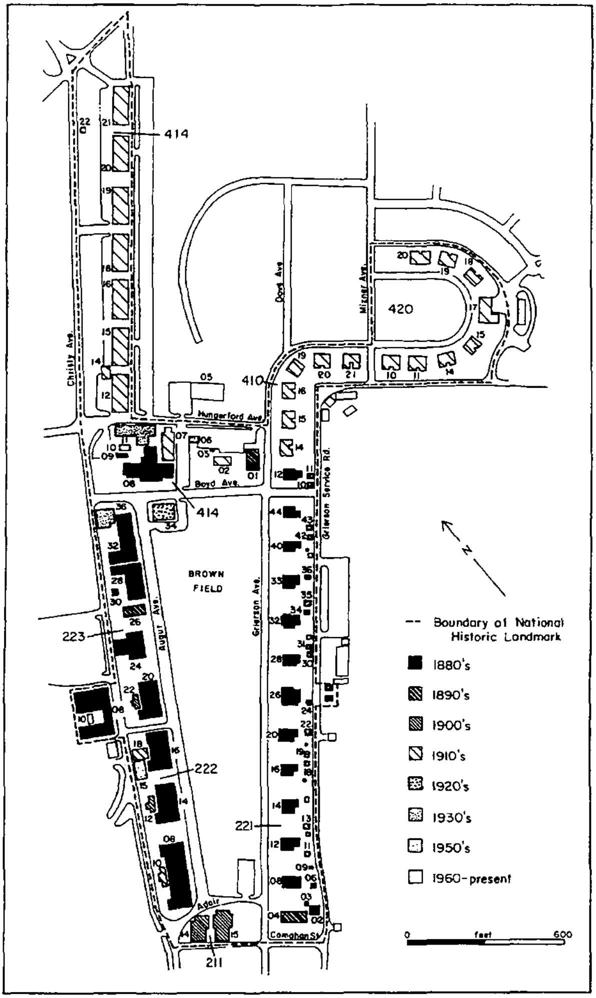

FIGURE 3.3-2 The Old Fort Area (Statistical Research 1995)

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restoration. The possibility of an interpretive center at the Garden Canyon Village Site is also under discussion, but no firm decision has been made to go forward with the project.

3.3.5 Consultation with Native Americans

Although none have been specifically identified, traditional cultural sites may exist within Fort Huachuca boundaries. The Tohono O'odham Nation, where many of the Sobaipuri settled after fleeing the San Pedro River Valley, represents the interests of these long-term Piman inhabitants of the region. Hopi elders believe their ancestors included prehistoric residents of the area. Consultations have also occurred and will continue with Apache communities in Fort Sill, Oklahoma, and at the White Mountain and San Carlos Apache Reservations in Arizona. Additional consultations will occur with Apache communities in New Mexico. Apache concerns include both Traditional Cultural Properties and the long presence of Apache Scouts at the installation.

The requirements of NAGPRA, including a 30-day work cessation when a burial site is discovered (unless a MOU has been approved by affected tribal groups), are followed with respect to all excavation or construction activity at Fort Huachuca.

3.3.6 Section 106 Coordination and Programmatic Agreements

All archaeological survey reports are submitted to the State Historic Preservation Officer (SHPO), as required by Section 106 of the National Historic Preservation Act. Surveys and reports are prepared for any ground disturbance, new construction, and historic structure maintenance/ renovation. SHPO consultation is required when a project may affect cultural sites or resources.

A 1986 programmatic agreement between the DoD, National Council of State Historic Preservation Officers (NCSHPO), and the Advisory Council on Historic Preservation (ACHP) is in place for the treatment of temporary World War II-era (1939-1946) wooden buildings. An MOU concerning repair and/or replacement of windows in historic buildings was signed by the SHPO, ACHP, Fort Huachuca, and US Army Training and Doctrine Command (TRADOC) in 1993. New guidance is now being issued from the DA concerning treatment of World War II temporary buildings if they are to be renovated and not demolished. Renovations will necessitate SHPO consultation, while demolition will not. Programmatic agreements currently under negotiation between the Arizona SHPO and Fort Huachuca include completion of the CRMP, monitoring of archaeological surveys and sites, and repair and maintenance of historic structures on post (DA 1995). No completion dates have been set for these agreements.

An effort to develop a nationwide programmatic agreement governing Cold War-era structures (1947-1991) is now getting started (Murray 1996). However, implementation will likely be several years in the future.

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3.4 AIR QUALITY

This section discusses baseline conditions for air quality and air pollution. Air pollution is a contaminant present in the atmosphere in sufficient quantities to be detrimental to the public's well being, human health, plant or animal life, or property. This baseline information would be used as a point of comparison when evaluating air quality impacts that may be caused by the proposed action and alternatives discussed in this EIS. Appendix B provides detailed information on baseline conditions.

Air quality is not routinely monitored at the installation but occasional measurements have been conducted. This section describes air quality measurements at Fort Huachuca and in the surrounding area; and compares them to current federal and state standards. Investigations were conducted of air pollutants released by stationary sources; on-road vehicle use including commuting to and from work by military and civilian personnel who reside on- and off-post; military training; activities including vehicle use on unpaved roads; and aircraft operations. Estimations of the concentrations of pollutants resulting from activities were made by using EPA guideline air dispersion models (Peterson and Lavdas 1986, Benson 1979, EPA 1991). For stationary sources, this process was conducted using either the EPA SCREEN model that estimates the highest downwind concentration under any wind conditions or the EPA model INPUFF 2.0 that performs a more refined dispersion calculation. For vehicles and aircraft, the investigations were carried out first by using EPA emission factors to estimate the quantities of pollutants released and then using the CALINE3 line source dispersion model or INPUFF 2.0 to predict the concentrations.

Sources of data that were used in the analysis include: (1) the comprehensive inventory of stationary air pollution sources at Fort Huachuca published in 1994 (Earth Technology Corporation 1994); (2) vehicle registration information and post population data; (3) details of military training programs; (4) aircraft operations data from Libby and Hubbard Airfields; and, (5) performance data and emission factors for vehicles and aircraft (EPA 1990).

3.4.1 Air Quality Standards

Fort Huachuca is located in the Southeast Arizona Intrastate Air Quality Control Region which encompasses the counties of Cochise, Graham, Greenlee, and Santa Cruz. Air quality regions in Arizona are identified by the extent to which they meet Ambient Air Quality Standards for five criteria pollutants: particulate matter smaller than 10 mm in diameter (PM_{10}), sulfur oxides (SOx), ozone (O_3), carbon monoxide (CO), and nitrogen dioxide (NO_2).

Arizona Ambient Air Quality Standards are promulgated by the Arizona Department of Environmental Quality (ADEQ). Federal Ambient Air Quality Primary and Secondary Standards are provided by the National Ambient Air Quality Standards (NAAQS), as established by the EPA (Clean Air Act, 42 U.S.C. 7470, et seq., as amended). Both federal primary and secondary standards for criteria pollutants were adopted by the State

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of Arizona (Table 3.4-1). Other federal and Arizona regulations establish standards pertaining to visibility-degrading pollutants especially near national recreation and wildlife areas, and to permitting of new and modified stationary sources. Air quality standards and regulations are expressed either as pollutant concentration or as the annual emission rate. Concentrations are expressed either in micrograms per cubic meter (μg/m^3) or parts per million by volume (ppm).

Table 3.4-1. National Primary And Secondary Ambient Air Quality Standards

		FEDERAL STANDARDS	
Pollutant	**Averaging Time**	**Primary**	**Secondary**
Ozone	1 hour	>0.12 ppm (235 μg/m^3)	Same as primary standard
Carbon monoxide	8 hours	^{3}9.5 ppm (10 μg/m^3)	Same as primary standard
	1 hour	>35 ppm (40 μg/m^3)	
Nitrogen dioxide	Annual average	>0.0534 ppm (100 μg/m^3)	Same as primary standard
	1 hour	—	
Sulfur dioxide	Annual average	0.03 ppm (80 μg/m^3)	—
	24 hours	0.14 ppm (365 μg/m^3)	—
Particulate Suspended Matter (PM_{10})	24 hours	>150 μg/m^3	Same as primary standard
	Annual arithmetic mean	>50 μg/m^3	
Lead	30-day average	—	—
	Calendar quarter	^{3}1.5 μg/m^3	Same as primary standard

Source: 40 CFR 50

3.4.2 Air Quality Conditions

Air quality in the vicinity of Fort Huachuca is very good. The area's windy conditions are not conducive to the buildup of pollutant concentrations. Daily winds tend to disperse adverse air emissions. Typical major sources of pollution such as heavy industry and fossil fuel power plants are not present in the area. The major sources of air pollution in the area are from aircraft, private vehicles, military vehicles, and gas heating emissions. Training exercises involving military vehicles, aircraft, and artillery also produce fugitive dust.

Fort Huachuca is within an area of air quality attainment for criteria pollutants. Air pollutant concentrations are not routinely monitored for the Fort Huachuca area; however, air quality in the area can be inferred from data obtained at the Tucson monitoring station, the nearest station to Fort Huachuca that monitors criteria pollutants. Air quality data from the Tucson station from 1990 to 1996 are presented in Table 3.4-2. The air quality at Fort Huachuca would be expected to be considerably better than Tucson. The area is far less urbanized than Tucson and gaseous pollutants would be expected to be substantially less.

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Table 3.4-2. Air Quality Monitoring Summary For Tucson Air Monitoring Stations[1]

Pollutant/Standard	1990	1991	1992	1993	1994	1995	1996
Ozone 1 hour >0.12 ppm	0	0	0	0	0	0	0
Ozone Max. 1 hour conc. (ppm)	0.09	0.08	0.08	0.09	0.08	0.118	0.093
Carbon monoxide 8 hour ^{3}9.5 ppm	0	0	0	0	0	0	0
Carbon monoxide 1 hour >35 ppm	0	0	0	0	0	0	0
Carbon monoxide Max. 1 hour conc. (ppm)	13.8	12.3	12.5	14.3	10.8	11.9	10.0
Carbon monoxide Max. 8 hour conc. (ppm)	6.8	6.4	6.1	6.5	6.0	6.0	5.2
Nitrogen dioxide Annual average >100 $\mu g/m^3$	No	NR	No	No	No	No	No
Nitrogen dioxide Max. 1 hour conc. $\mu g/m^3$	.114	.105	.092	.081	.095	.078	.075
Total suspended particulates 24 hour >260 $\mu g/m^3$	0	NR	NR	NR	NR	NR	NR
Total suspended particulates 24 hour >150 $\mu g/m^3$	0	NR	NR	NR	NR	NR	NR
Total suspended particulates Max. 24 hour conc. ($\mu g/m^3$)	89	NR	NR	NR	NR	NR	NR
Particulate lead Highest quarter ^{3}1.5 $\mu g/m^3$	0	0	0	0	0	0.02	0.05
Inhalable particulates (PM_{10}) 24 hour >150 ($\mu g/m^3$)	0	0	0	0	0	0	0
Inhalable particulates (PM_{10}) Max. 24 hour conc. ($\mu g/m^3$)	114	81	114	88	71	132	123

Source: ADEQ, 1990, 1991, 1992, 1993, 1994, 1995, and 1996

1. All data are for the Tucson area but the placement of the stations recorded in the table varies across the city from year to year. This is because the same station did not necessarily monitor the same pollutants each year. Because the Fort Huachuca/Sierra Vista area is far less urbanized than the Tucson area, presented values are the lowest for each reported pollutant in the Tucson area.
2. NR = Not reported.
3. No = No violations of the quarterly standard for any of the four quarters.

Other available monitoring data also indicate that the air quality in the immediate Fort Huachuca area meets Ambient Air Quality Standards for criteria pollutants, and has met the standards since the inception of monitoring programs. Since Sierra Vista monitoring sites are close to Fort Huachuca, Sierra Vista data provides applicable characterization of Fort Huachuca air quality. Monitoring programs were conducted between 1977 and 1983 by the Arizona Office of Air Quality Control, ADEQ who monitored CO and O_3 in Sierra Vista. The routine CO/O_3 monitoring program ended in 1984 in Sierra Vista and several other Arizona cities with the justification that CO and O_3 concentrations would continue to decrease through the year 2000.

CO results primarily from automobile emissions, O_3 comes from photochemical reactions involving hydrocarbons, and NO_2 results from vehicle emissions. CO concentrations become a problem during the winter months and O_3 levels increase to levels of concern during the summer. Levels of both these pollutants

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probably steadily decreased because of introduction of newer, more effective air pollution controls on automobile emissions and replacement of older, less efficient vehicles with newer models. Summary data reports were published by ADEQ (Guyton 1984; Guidden 1993).

Between 1974 and 1988 the Office of Air Quality Control also monitored total suspended particulates (TSP) in Sierra Vista. The TSP measurements include particles in the PM_{10} size range and PM_{10} levels can be calculated from TSP values. The Arizona Office of Air Quality Control monitors PM_{10} because particles in the PM_{10} size range are respirable, thus influencing human health. Calculated PM_{10} levels for the Sierra Vista area were well below the 50 μm^3 compliance standard and actually decreased during the monitoring period. The decreasing trend is enigmatic because wind erosion is a natural occurrence in arid regions of the Southwest; the areas of blowing dust during windy periods are fairly common and a major contributing source of airborne particulates. One plausible explanation for decreasing levels of TSP and PM_{10} in the region is the replacement of dirt roads and areas of bare ground with pavement and buildings and completion of large-scale construction projects initiated during the period of monitoring. Motor vehicle traffic (including tracked vehicle) on unpaved roads or cross-country routes while training is a potential source of TSP and PM_{10} at Fort Huachuca.

No data are available on the criteria pollutants, sulfur oxides and nitrogen oxides, but these pollutants are less likely to exceed standards than the others. Vehicle engines and industrial processes are the major sources of these two pollutants. Potential industrial sources of SO_x in the region are copper smelters in San Manuel, northeast of Tucson, and near Cananea, Sonora, Mexico. Potential sources of these two pollutants at Fort Huachuca are engines in vehicles and aircraft, diesel generators, boilers and other heating equipment, and certain military ordnance. However, fuels and ordnance at Fort Huachuca are typically low in sulfur and would not contribute measurably to background levels of SO_x and NO_2 in the region.

Earth Technology (1993) inventoried stationary air pollution sources (e.g., boilers, incinerators, and generators) and quantities of air pollutants released from facilities at Fort Huachuca. Data about mobile sources were gathered from the post motor vehicle registration officer, government and contractor personnel knowledgeable about motor vehicle use under different official programs at Fort Huachuca, and the Chief of Air Traffic Control at LAAF to characterize air pollution contributions from motor vehicles and aircraft at Fort Huachuca. These data were used with air dispersion models to predict air pollution concentrations originating from Fort Huachuca under different scenarios and weather conditions.

3.4.3 Climate

The area has an arid climate with relatively mild winters and warm summers. The summer average high temperature is 88°F and the average winter low is 32°F. Clear skies or high thin clouds are common and permit intense surface heating during the day and rotational cooling at night. This condition creates an

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average diurnal temperature fluctuation of almost 30°F. Annual precipitation is 14 to 26 inches, and the average wind velocity is 7 mph with daily gusts of 20 to 30 mph common.

The Huachuca Mountains receive an average annual precipitation exceeding 30 inches per year (Arizona Department of Water Resources [ADWR] 1988). Precipitation is bimodally distributed, with approximately 60 percent of the total falling during the summer "monsoon" season, and roughly 30 percent occurring during winter months. Spring and fall are typically dry (Sellers and Hill 1974). Maximum "monsoonal" precipitation falls on the southeast (windward) side of the Huachuca Mountains (ADWR 1988).

3.4.3.1 Severe Weather

The potential for severe weather at Fort Huachuca as well as Sierra Vista and Huachuca City is relatively low. Tropical storms and hurricanes from the Pacific and Gulf of Mexico have on occasion provided enhanced rainfall in the area, but these systems lose most of their organization before reaching southeastern Arizona. Wintertime Pacific systems occasionally bring extended rainstorms to the area, but most recording stations in the San Pedro River valley "have never received more than three inches of precipitation in 24 hours" (Sellers and Hill 1974). Tornadoes are rare in southeastern Arizona, but summertime storms may result in hail and high winds such as reported near Benson, Arizona (30 miles north of Fort Huachuca) on July 28, 1952. The 45-minute storm left 3 to 4 inches of hail on level ground, with some hailstones measuring up to 1.5 inches in diameter (Sellers and Hill 1974).

3.4.3.2 Fort Huachuca

The climate at Fort Huachuca is as varied as its topography, ranging from hot, dry valley bottoms to cool, moist mountain peaks. The principal meteorological station is located at LAAF, elevation 4,664 feet above mean sea level (MSL), although the EPG maintains other stations on Fort Huachuca. Average minimum and maximum daily air temperatures at the LAAF station are 35°F in January and 90°F in June (ENRD 1995). Average annual precipitation at Fort Huachuca is 15 inches. The intensity and frequency of storms varies greatly from one year to the next, so that the seasonal precipitation is normally either much below or much above the long-term average value, usually the former. Roughly one tenth of the winter precipitation falls as snow and this rarely stays on the ground for more than a day or two. Average monthly and maximum precipitation amounts at Fort Huachuca are shown in Figure 3.4-1.

3.5 NOISE

This section discusses the noise attribute of the affected environment. Information about noise metrics, models, and general principles of acoustics is described in Appendix D: Noise Investigation. A more complete discussion of these subjects as they apply to this EIS is also presented in Appendix D.

Noise can be defined as unwanted sound. Sound is mechanical energy transmitted by pressure waves in a compressible medium such as air. This baseline information is used as a point of comparison when evaluating noise impacts that may be caused by the proposed action and alternatives discussed in this EIS.

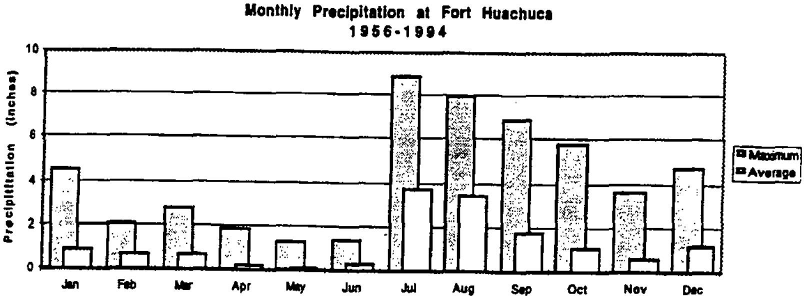

Figure 3.4-1. Average Monthly Precipitation at Fort Huachuca, 1956-1994

3.5.1 Installation Compatible Use Zone Survey (Noise)

The noise levels at Fort Huachuca and the nearby communities were studied in detail in the preparation of the Fort Huachuca Installation Compatible Use Zone (ICUZ) survey that was conducted for Fort Huachuca by the U.S. Army Environmental Center. Monitoring was conducted in 1992 at seven sites in Sierra Vista, three sites in Huachuca City, and four sites within Fort Huachuca.

Fort Huachuca sites were selected near Libby and Hubbard Airfields because aircraft were expected to be the major contributor to the noise background. At each site, for one week during July and another week during September, equivalent sound levels were measured during the day and during the night, and the day-night average sound levels were computed. These values were subsequently used to compute equivalent sound levels for the daytime and nighttime periods.

Impulsive sound levels such as those that arise from weapons firing or from detonation of explosive projectiles have a fast rise time and brief duration. The peak levels from such sounds were not detected by the slow response meter used in the ICUZ survey. The energy of impulsive sounds did contribute to the total energy detected by the meter and to the computed equivalent sound levels if any were taking place during the measurements.

The off-post monitoring sites exhibited much lower noise levels than the sites near the Fort Huachuca airfields. The EPA has set a goal of achieving day-night average sound levels of average daily noise level (ADNL) of 55 decibels (dB) for residential areas. A dB is a unit for expressing the relative intensity of sound on a scale from zero for the average least perceptible sound to about 130 for the average pain level. The

ADNL 55 dB goal does not consider the costs of attainment. The Federal Interagency Committee on Noise has taken economic feasibility into consideration in recommending a threshold for residential land use compatibility of ADNL 65dB (FICUN 1980).

Most of the off-post monitoring sites have a distinct diurnal variation with a noise peak between 0600 and 0700 hours (6 and 7 AM) and another peak between 1800 and 1900 hours (6 and 7 PM). This behavior indicates that the dominant noise source at those sites is vehicular traffic. Vehicular traffic is at its highest level during the morning and evening commuting periods. Some of the off-post sites have a higher and relatively constant noise level from 0800 to 1800 hours (8 AM to 6 PM) than at other times during the day. Noise at these sites is dominated by commercial activities such as delivery vehicles. Many of the measurements show brief high intensity events mainly during the daytime hours. These generally result from passage nearby of unusually noisy vehicles such as large trucks or emergency vehicles.

The on-post sites generally have higher noise levels from roughly 0800 hours (8 AM) until 1800 hours (6 PM) than during the remainder of the day. The measurements were made near Libby and Hubbard airfields, and aircraft operations including maintenance that involves ground engine run-up are concentrated during normal working hours. Hubbard Airfield is an unimproved facility at which take-off and landing under simulated tactical airlift conditions are practiced. Operations there are conducted almost exclusively during daylight hours.

3.5.2 Other Noise Measurements

As part of the EA for the Fielding and Operation of the M-1 Tank at Fort Huachuca, Arizona (Chambers 1994), a single daytime measurement of equivalent sound level was conducted in October 1991. The measurement was made between 1520 and 1530 hours (3:20 and 3:30 PM) and is not a statistically significant sample because of its short duration. Although at this time of day the commuter traffic level would not be at its maximum official traffic, the majority of heavier and noisier vehicles would be near their highest level. During the measurement period, there was a noise contribution from a nearby construction project and from a passing helicopter. The result of the measurement was a ten minute equivalent sound level of 58.4 dBA. This is higher than the mean daytime value for all but one of the ten off-post monitoring locations, and when compared with the highest daily equivalent sound levels over the entire two weeks of measurements, it is somewhat above the median. This measurement shows similarity between off-post measurements and on-post measurements made at points reasonably distant from the airfields.

3.5.3 Sierra Vista Municipal Airport

Sierra Vista Municipal Airport is the same facility as LAAF, and is operated as a joint use airport. The most recent noise contours developed for this airport are associated with the Airport Master Plan for Sierra Vista, developed in 1989 by Coffman Associates Airport Consultants (Coffman 1989). The noise element of that master plan estimated the 1989 ADNL 65, 70, and 75 dB noise contours and observed that all of the land areas affected by aviation noise levels exceeding ADNL 65 dB 3281 acres (5.97 sq. mi.) were contained within the Fort Huachuca Military Reservation, and that all existing and planned land use was compatible with the estimated noise levels.

Noise contours were also developed on the basis of activity forecasts for the year 2010, and a three percent increase in the area of the ADNL 65 dB contour was predicted over the 1989 area. It was also observed that all aircraft noise levels in excess of ADNL 65 dB 3936 acres (6.15 sq. mi.) would be contained within the Fort Huachuca Military Reservation, and that all existing and planned land use would be compatible with the estimated noise levels. Noise levels may increase during airshows, musical concerts, and mobilization.

3.6 GEOLOGY AND SOILS

This section discusses the baseline elements of geology and soils. It includes regional geology, geomorphology, mining, and seismic risk. Information for this section was collected from existing reports and studies. No new field work was conducted.

3.6.1 Regional Geology

The geology of the area between the San Pedro River and the Huachuca Mountains is rather complex. The remnants of a volcano, active from about 66 to 73 million years ago, is exposed in the beds of the Babocomari and San Pedro Rivers and in the numerous rocky hills extending from the town of Tombstone to the northern part of the Fort Huachuca East Range. Weathering and erosion have obscured most of the original crater; however, beneath the relatively young alluvium of the Babocomari and San Pedro Rivers lies an undulating surface of hard volcanic rock (Cochise County 1993). Recent geophysical studies conducted by Fort Huachuca and the U.S. Geological Survey (USGS) indicate that volcanic features play an important role in defining the local groundwater system.

The Upper San Pedro Basin (USPB) in general is underlain by several hundred feet of consolidated and unconsolidated sedimentary deposits, most of which are capable of transmitting groundwater. These deposits may be more than 1,000 feet (300 m) thick in the south, where basin and range type faulting has produced a deep graben structure (BLM 1989). The valley fill deposits are less uniform along the northeast fringe, where they are bisected by deep structural faults and at least one volcanic body. Geophysical studies confirm the presence of a volcanic body at the approximate confluence of the Babocomari and San Pedro Rivers.

Most of the western boundary deposits follow the crest of the Huachuca Mountains, which vary in elevation from about 5,000 to 8,400 feet (1500 to 2520 m)above mean sea level. This mountain range is composed of intensely folded and faulted terrain in which marine limestones have been thrust beneath granitic continental margin. A series of these thrust faults creates a zone of weakness that forms a broad arc starting on the westernmost flank of the Mule Mountains, south into Mexico, north up the spine of the Huachuca Mountains, and finally to the northwest to where it dissects the Santa Rita Mountains (Arizona 1980). The principal regional hydrostratigraphic features are the upper and lower units of unconsolidated basin fill and overlying floodplain alluvium. These units form the regional and local aquifers.

3.6.1.1 Basin Cross-Sections

The historical generalized cross-section shown in Figure 3.6-1 has been used in a number of publications to represent the stratigraphy of the San Pedro River basin. Although it is an appropriate generalization of basin and range geology prevalent throughout much of Arizona, it may not accurately depict the basin geology in the USPB near Fort Huachuca. In the Fort Huachuca area, the Tombstone volcanic center has altered the basin and range scenario significantly. Several investigators have constructed representative cross-sections in the area of Fort Huachuca. Many cross-sections have been presented to illustrate that the San Pedro River and the alluvial aquifer that surrounds it become isolated from the basin fill where the stream course crosses the volcanic terrain. Interpretation of these cross-sections, as well as other geologic information, was used to construct the cross-section shown in Figure 3.6-2. This hypothetical cross section may be a more accurate characterization of subsurface conditions, with some variation in elevation along the western boundary, from about a half mile north of Lewis Springs to north of Fairbank.

The remnants of a volcano, active from about 66 to 73 million years ago, are exposed in the beds of the Babocomari and San Pedro Rivers and in the numerous rocky hills extending from the Tombstone to the northern part of the East Range at Fort Huachuca (Moore 1993). Weathering and erosion have obscured most of the original crater; however, beneath the relatively young alluvium of the Babocomari and San Pedro Rivers lies an undulating surface of hard volcanic rock (Cochise County 1993). A later period of volcanism (30 to 40 million years ago) uplifted the Huachuca Mountains. This period of volcanic uplift was characterized by the release of large volumes of ash and the accumulation of large debris fields on steep mountain slopes. As the debris slopes became unstable, the volcanic ash slid or was washed to the base of the mountain front. This process formed a pediment composed of eroded volcanic detritus and entrained material scoured from the original mountain slopes. With time the minerals in the detritus dissolved and re-crystallized, cementing the once loose and porous mix into a nearly impermeable mantle encircling much of the northern and eastern flanks of the Huachuca Mountains. This formation, identified as the Pantano (Brown et al. 1966) or Tertiary Conglomerate (Arizona 1980), inhibits the flow of mountain runoff into the regional aquifer.

3.6.2 Mining

Mineral exploration and exploitation has been an important economic, social, and historic factor in the development of the USPB. Development of silver and copper mines remains one of the significant factors in the population of Cochise County, Arizona and Sonora, Mexico. While the majority of mines have closed on the American side of the border, mines are active and expected to expand in Sonora. Withdrawal, use, and disposal of water at copper mines in the Cananea mining district in Mexico is expected to have continuing impact upon surface water and groundwater availability, supply, and quality. The development of water

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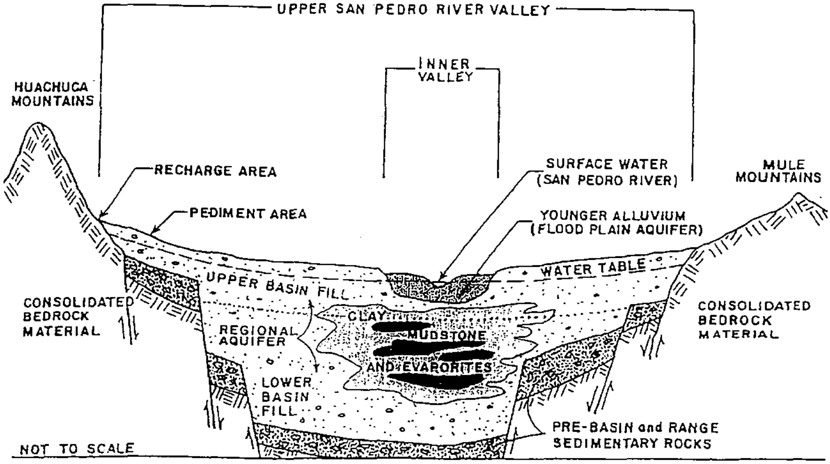

FIGURE 3.6-1 Historical generalized Cross-Section of the USPB (No Source)

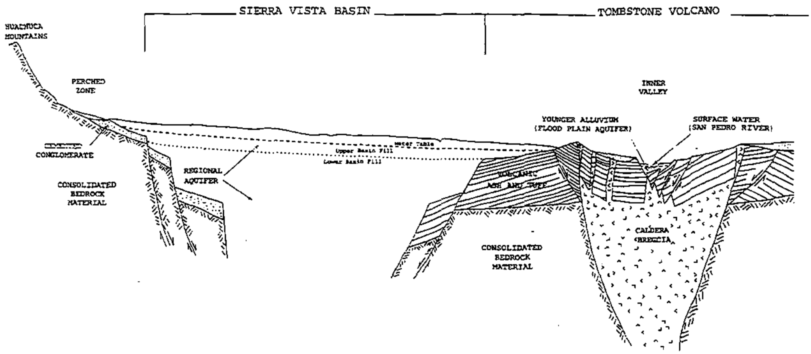

FIGURE 3.6-2 Hypothetical Cross Section of the Sierra Vista Sub-Basin near Charleston

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resources in the upper reaches of the San Pedro watershed may prove to be a significant factor in regional economic development, health, and growth.

Little information is available on past exploitation of mineral resources on what is now Fort Huachuca (ENRD 1995). Silver and lead have been reported to occur at the location of the Manila Mine (Section 6, T22S, R19E), and gold and lead have been reported in the vicinity of Huachuca Peak. Scheelite, a mineral containing tungsten, was mined in Section 17, T23S, R20E, just south of the military reservation. Sand, and perhaps granite, have been mined in Slaughterhouse Wash along the northern slope of the Huachuca Mountains. Sand, gravel, and crushed rock have also been mined in Garden Canyon. Overall, there is little indication that mineral exploration will be a significant factor in or around the Huachuca Mountains.

3.6.3 Seismic Risk and Geomorphic Hazards

The primary seismically active area affecting southeastern Arizona is an area near Colonia Morales, Sonora, Mexico; about 100 miles southeast of Fort Huachuca. In 1887, that locale was the site of an earthquake with an impact of XI to XII on the Modified Mercalli Scale (MMS), which equates to an energy equivalent to a Richter number of about 8. Reports from the Tombstone area indicate that this quake resulted in damage with an impact of VII MMS (5.5 Richter) in the Upper San Pedro Valley, which tumbled adobe walls and cracked building foundations (Dubouis and others 1982 cited in Hereford 1993). The U.S. Department of Commerce, Environmental Science Service Administration includes Fort Huachuca, along with the entire state of Arizona, in the VII MMS intensity earthquake zone (Algermissen 1969). An earthquake of this magnitude would cause serious damage to buildings, bend railroad tracks, and cause landslides on unstable slopes.

Facilities construction within the Fort Huachuca cantonment area has generally avoided floodplains and flood prone areas. There is no history of flooding damage in developed areas (Zillgens 1991b). The largest watershed is Garden Canyon, and ground-disturbing activities in that area are generally related to outdoor recreational equipment and structures. A study by Simon and Li Associates, Inc. (SLA 1988) calculated the 100-year peak flow at the mouth of Garden Canyon as 6,701 cubic feet per second (cfs). This flow, however, is released over a broad area of undeveloped rangeland and offers little threat of property damage. The relatively low density of development and limited impervious cover or channelization has minimized impact on downstream land use.

3.6.4 Soils

Fort Huachuca has a diverse assortment of soil types (Figure 3.6-3). This diversity is directly related to differences in climate, parent material, and topography at the installation. The soils exhibit wide variations in depth, texture, and chemical properties. Roughly 30 percent of the soils are less than 2 feet (0.6 m) in depth over bedrock. Soil physical and chemical properties have an influence on the plant communities that exist at

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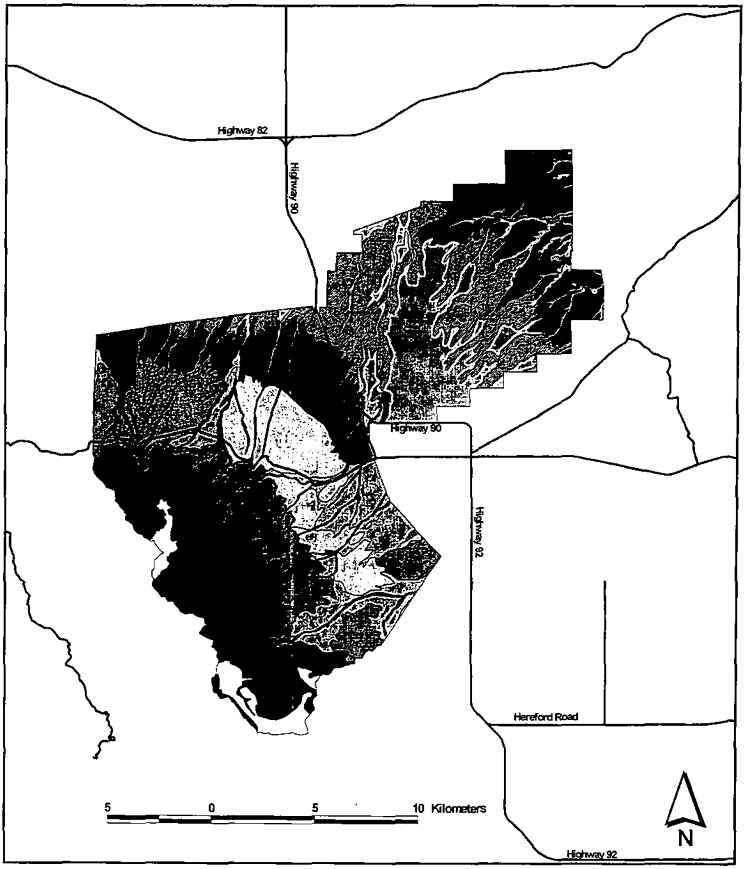

FIGURE 3.6-3

Fort Huachuca: Soils

SOURCE: NRCS, 1997

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the installation and the uses and management of soils by the Army. Soil management is a significant operational consideration at Fort Huachuca. The Soil Survey of Fort Huachuca (NRCS 1997) characterizes the types of soils that occur at the installation, locations of the soil types, and potential uses.

Many soils in the hilly and mountainous areas, particularly on the South and West Ranges, are shallow with steep slopes; these soils tend to have a low available water capacity and susceptible to erosion. The high sodium and gypsum contents of many soils on the East Range make these soils subject to gully erosion and piping; they also are very corrosive to concrete and steel. The soil of the cantonment area consists of alluvial fan soils (white house complex, lanque soil, courtland-sasabe-draspar complex, blacktail-pysatt complex, blakeney soil, and combate soil) (Svetlic 1994). Almost one quarter of the land area of the post has deep red clay soils that have slow permeability and tend to be poorly drained. They become very slippery when wet and susceptible to compaction. Other properties of soils at the installation influencing land use and management are gravely or rocky soils, soils with hard pans, and deep, doughty, sandy soils.

3.6.5 Erosion Control

Soil erosion is minimized on training areas at Fort Huachuca using a combination of erosion control techniques and regulation of activities on the ranges. Erosion control techniques implemented at the installation have helped reduce erosion and partially restore native plant communities. The regulation of activities is being enforced by Fort Huachuca Regulation 385-8, Range and Training Area Operation. In 1998 the Fort completed an East Range Watershed Improvement Plan for erosion control and groundcover restoration of the East Range (ENRD 1997b).

Erosion control techniques are currently used on the East Range to help prevent erosion or restore sites that show signs of erosion. Activities on all ranges at the installation are regulated by the range officer to ensure the ecological stability of the area. Vehicles are currently confined to pre-existing roads and trails.

Other erosion control measures being employed on training ranges include scheduling training during the driest seasons (April through June) and allowing sufficient time for soils to dry out after heavy rains before resuming off-road training exercises. Rotating activity on training lanes to allow at least one year of inactivity between training exercises allows soil and vegetation to naturally recuperate before the next training session.

3.7 HYDROLOGY AND WATER RESOURCES

This section presents the existing hydrological conditions within the region, including detailed information on groundwater usage and trends at Fort Huachuca. This section also presents the baseline conditions for surface water, groundwater, and water quality. This baseline information will be used as a point of comparison when evaluating hydrological impacts that may be caused by the proposed action and the alternatives discussed in this EIS.

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A compilation of relevant data and reports is provided in Appendix A. This appendix is intended to provide the reader with additional information on hydrogeological reports discussed in this EIS. Although not an exhaustive review, the documents summarized here represent the principal body of knowledge on the hydrogeology of the USPB.

3.7.1 Background

Numerous studies have been conducted to gain a better understanding of the hydrogeology of the USPB. Some of these studies involved actual field survey and data collection, some were modeling efforts, and others provided a review of existing information. All of these studies differ to some extent in purpose and scope but can be grouped into four general categories (which overlap): basic research, water supply, planning, and mitigation.

Because most of these studies are based upon the same data sources, there is much repetition, both in the data presented and in the interpretation of the data. It should be recognized that much analysis and many conclusions have been drawn from a relatively small data set. Despite ongoing efforts to fill the gaps in the knowledge base, none of the studies available to date fully describes or explains the complex hydrogeology of the USPB.

The scientific community is debating the role and effect of regional volcanism on groundwater resources in the USPB (see Vionnet and Maddock 1992; ASL 1994; Geraghty and Miller 1995; Wynn and Gettings 1997). Recent geophysical data has produced a new conceptual model that differs from the previous computer models. The geographic region south of the confluence of the Babocomari and San Pedro Rivers is the focus of this debate. While immediately relevant to the geographic areas covered in this EIS, it is clear that such controversial scientific and conceptual issues will not be resolved before this EIS is published. At present, there is not adequate scientific data to prove long-held assumptions or support definitive conclusions regarding the complexities of local hydrology; however, there is evidence to support general findings.

There has also been considerable speculation regarding the impact of groundwater development upon surface flows of the San Pedro River. These issues have been contested in both scientific and legal forums (USDC 1995). Given this level of controversy, it is clear that detailed questions regarding the long-range impact of regional groundwater development on surface water features can not currently be answered conclusively. The exact scientific cause and effect will remain the subject of scientific investigation. However, there is an adequate volume of scientific evidence, including expert testimony provided by the State of Arizona that development and use of groundwater on Fort Huachuca has "not caused a change in groundwater discharge to the San Pedro River, nor has it diminished the river's surface water flow rate or volume" (ADWR 1996).

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3.7.2 Hydrology

This section summarizes regional and local surface and groundwater resources including the major streams, and relevant geologic and hydrogeologic information (Figure 3.7-1).

3.7.2.1 Regional Surface Water Resources

The San Pedro River is a major regional stream, draining a land area of approximately 4,600 square miles (11914 sq. km) and extending almost 200 miles (322 km) from its headwaters in Sonora, Mexico, to its confluence with the Gila River near Winkleman, Arizona.

The San Pedro is one of the few perennial rivers in southern Arizona, representing a remnant of conditions that once characterized the region. Maintaining existing surface water flows, velocities, and patterns is essential to the preservation of the cienega/bosque environment and has been deemed a regional objective by federal and state resource management groups, organizations, and agencies (AZ ARNG 1997).

The San Pedro River is part of an alluvial river system; that is, a river which is formed in fluvial sediments transported, deposited, and reworked by the river itself. The river and its riparian zone are dynamic systems undergoing constant adjustments in response to changes in runoff, sedimentation rates, and channel and floodplain conditions (BLM 1989). Today, most of the main channel of the San Pedro River is incised. By most accounts, the San Pedro river system has degraded both in terms of historic hydrologic condition and habitat diversity. That degradation is associated closely with an episode of human and flood induced channel entrenchment that occurred between 1880 and 1926, which resulted in the loss of cienega habitat and further incised entrenched reaches (BLM 1987). The BLM (1989) reports that incision of the channel has resulted in declines in the local water tables.

Entrenchment set into motion a number of important adjustment processes-geomorphic, hydrologic, and biologic. Most of those adjustments are still continuing and may have an influence on future resource conditions along the San Pedro River (BLM 1987). Where floodplains are narrow, channel incision has been on the order of 10 feet (3 m). In other sections of the river, erosion has progressed laterally to create a broad channel occupied by a relatively narrow zone of river flow during periods of drought. During floods, the channel is filled by a turbid, erosive river.

Following the rapid sequence of entrenchment between 1880 and 1926, the San Pedro River has, and is continuing to undergo an evolution to a new dynamic equilibrium condition which reflects current hydrologic and land use conditions. That evolution consists primarily of widening, bar development, and the creation of floodplain. Widening is the primary prerequisite for re-establishment of stable floodplain vegetation communities, which contribute to sediment deposition and the development of properly functioning floodplains (BLM 1989).

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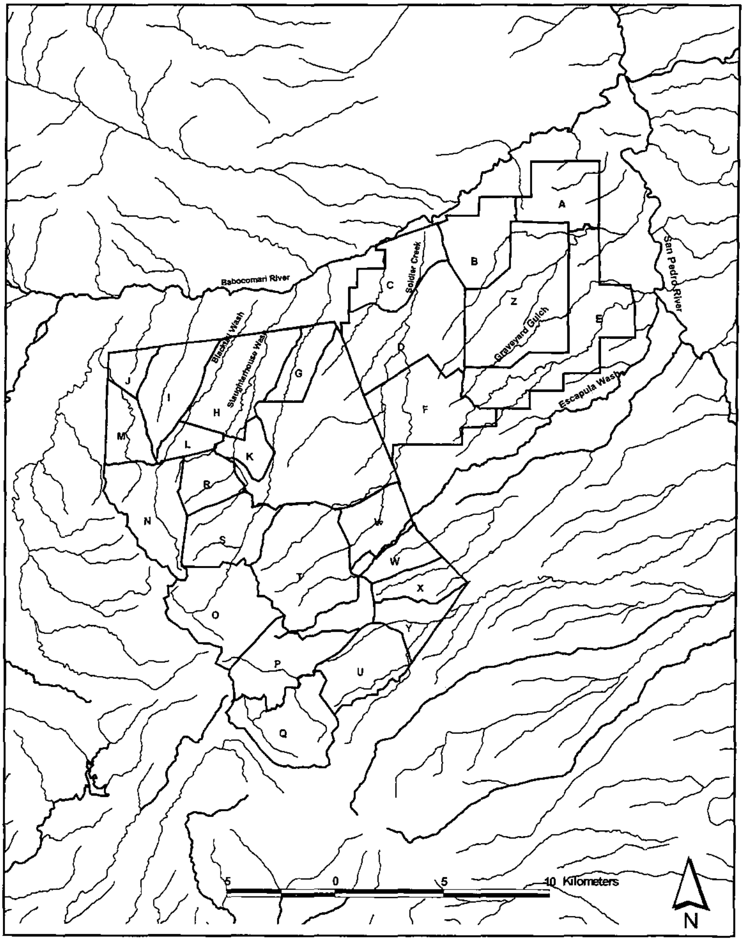

FIGURE 3.7-1

Fort Huachuca: Water Resources

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Surface water in the San Pedro River is comprised of precipitation and snowmelt runoff and baseflow from groundwater. Much of the San Pedro River now exhibits an intermittent flow regime with seasonal appearance and disappearance of surface water due to the regional climate and the timing of water uses along the river (ADWR 1991). During winter and early spring, the seasons of low water use, the rate of groundwater discharge to the river exceeds the rate of use by phreatophytes (deep-rooted plants that obtain water from the water table or soil above it) and agriculture. The result of the excess water supply versus demand is surface flow in the river. During other seasons, the rate of water use by riparian vegetation and by crop irrigation near the river exceeds the rate of groundwater discharge to the river and the surface flows disappear, except following rainfall events (ADWR 1991). River discharge rates are not only influenced by the amount and timing of runoff and groundwater discharges, but also by channel and floodplain characteristics and losses due to evaporation, groundwater recharge, and man-made diversions and withdrawals (BLM 1989).

Flow in the San Pedro River and its tributaries is variable, fluctuating radically from season to season and year to year, as well as exhibiting longer-term variations (ADWR 1991). High flows or low flows may occur several years in succession and low annual flows may follow high annual flows. Flow patterns are distinct, with flooding in winter and summer separated by low flow periods during spring and autumn. As is characteristic of most lower elevation southwestern streams, a large percentage of the total water yield occurs during infrequent flooding events (BLM 1989). Much of the flow in the San Pedro River occurs in spikes of high intensity but short duration caused by intense summer or winter storms. Runoff from these storms floods the river for short periods and also recharges the floodplain alluvial aquifer (W&EST 1996). The monthly flows are characterized by annual minimum flows in late fall and late spring of each year and annual maximum flows in the summer of each year. The minimum flows occur in late fall during the driest part of the year and in the spring when riparian vegetation begins leafing. High flows are generally a result of summer thunderstorm activity or cyclonic storms in the fall (ADWR 1991).

Mean annual discharge of the San Pedro River has averaged about 59 cfs at the Charleston station over the period of record (BLM 1989). Annual flows at Charleston have been about 79 percent higher than at Palominas due in part to the larger contributing watershed and the correspondingly larger peak flows at Charleston, and in part to the substantial groundwater contribution to the stream between Palominas and Charleston (BLM 1989). At Charleston, discharge has been less than 10 cfs about 30 percent of the time and greater than 100 cfs less than 10 percent of the time during the period of record (BLM 1989). Osborne and Lane (1984, cited in BLM 1987) researched climatic change and streamflow in the Southwest and report that there is some evidence that summer precipitation has declined in the region since the turn of the century. From 1930 to the present day, low flows have generally declined. Trends from about 1913 to 1923 are similar to the recent 10-year period (Geraghty and Miller 1995). The discharge during the wet

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season from mid-June to mid-October has deceased since 1960 from an average discharge at Charleston of 154 cfs prior to 1960 to an average of 86 cfs after 1960 (Hereford 1993).

Surface water discharges originating within the San Pedro Basin are tributary to either the San Pedro or Babocomari Rivers. The Basin also includes several smaller watersheds that are locally significant but contribute little to the regional surface and groundwater resources. The Babocomari drains the northwestern sections of the Sierra Vista subwatershed including the Mustang Mountains, Canelo Hills and the northern end of the Huachuca Mountains. It discharges into the San Pedro River just south of Fairbank. The Babocomari River is ephemeral throughout most of its length although a reach near the headwaters about 15 miles above its confluence with the San Pedro and another reach about four miles above the confluence sustain perennial flow due to special geologic conditions (ADWR 1988). These two reaches of the Babocomari sustain perennial flow for approximately 12 miles (19 km). The area near the Babocomari Ranch appears to be strongly influenced by the presence of a volcanic dike which may restrict the flow of groundwater and force it to the surface (ADWR 1991). Several drainages including O'Donnell Creek, Turkey Creek and Lyle Canyon flow into the Babocomari and probably contribute runoff during flood events. Flows in the Babocomari and its tributaries are not regularly gauged.

Most of the information concerning the flow regime in the Babocomari was acquired by Schwartzman (1990) during research conducted for a graduate thesis. Perennial and seasonally flowing portions of the Babocomari are supported by shallow water tables and generally exhibit stable baseflows between late October and early April. Winter rainfall may cause short-term runoff events between December and February. Stream flows are depleted during the hot summer months preceding the monsoon season of mid-July through late September. The monsoon rains generally restore stream flows to or above the winter baseflows. High runoff periods are associated with individual monsoonal rainfall events. Stream flows may fall below winter levels towards the end of the growing season in early October and return to winter conditions after the growing season. Schwartzman (1990) divided the Babocomari into ten sections and reports the results of stream gauging conducted in March and June of 1988. Streamflow ranged from 0.01 cfs to 2.72 cfs depending on the stream section in March and from 0.29 cfs to 0.35 cfs in the only three sections where measurable flow occurred in June. Sharma et al. (1997) report measurements on the Babocomari ranging from no flow to 1.5 cfs for intermittent gauging between 1990 and 1995. However, Sharma et al. (1997) did not feel their data were representative and state that an accurate data set of generated surface flows at this site was not feasible.

3.7.2.2 Surface Water at Fort Huachuca

Fort Huachuca lies in the Babocomari and the Garden Canyon watersheds, as defined by the NRCS. Combined, these watersheds represent a 539 square mile (1396 sq. km) drainage area making up 31.7 percent of the USPB (ENRD 1997a).

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A majority of the surface water features on Fort Huachuca are ephemeral streams, consisting of dry washes, arroyos, or continuous and discontinuous gullies. Ephemeral streams are usually dry and only flow in response to precipitation events that are significant enough to achieve runoff conditions. Ephemeral streams on Fort Huachuca are typically narrow channels with a sand and gravel layer at the bottom of the channel. Some of these channels are deeply entrenched. The channels serve to carry runoff to larger drainage systems.

Fort Huachuca has approximately 4.5 miles (7.2 km) of perennial streams. Garden canyon has 3.5 miles (5.6 km) of perennial reaches. Huachuca Canyon has 0.75 miles (1.2 km) of perennial stream segments. Minor lengths of perennial reaches also occur in McClure and Blacktail Canyons.

3.7.2.3 Regional Geology and Hydrogeology

The geology of the area between the San Pedro River and the Huachuca Mountains is complex. The remnants of a volcano, active from about 66 to 73 million years ago, are exposed in the beds of the Babocomari and San Pedro Rivers and in the numerous rocky hills extending from the town of Tombstone to the northern part of the Fort Huachuca East Range. Weathering and erosion have obscured most of the original crater; however, beneath the relatively young alluvium of the Babocomari and San Pedro Rivers lies an undulating surface of hard volcanic rock (Moore 1993). The degradation process formed a pediment composed of eroded volcanic detritus and entrained material scoured from the original mountain slopes. The minerals in the detritus dissolved and re-crystallized over time, thereby cementing the once loose and porous mix into a nearly impermeable mantle encircling much of the northern and eastern flanks of the Huachuca Mountains. This formation, identified as the Pantano (Brown et al. 1966) or Tertiary Conglomerate inhibits the flow of mountain runoff into the regional aquifer.

The USPB in general is underlain by several hundred feet of consolidated and unconsolidated sedimentary deposits, most of which are capable of transmitting groundwater. These deposits are not uniform and may be more than 1,000 feet (300 m) thick in the south, where basin and range type faulting has produced a deep graben structure (BLM 1989) and significantly more shallow in other areas. The valley fill deposits along the northeast fringe are bisected by deep structural faults and at least one volcanic body. The principal regional hydrostratigraphic features are the upper and lower units of unconsolidated basin fill and overlying floodplain alluvium. These units form the regional and local aquifers.

Geophysical studies confirm the presence of a volcanic body at the approximate confluence of the Babocomari and San Pedro Rivers. As part of recent and continuing studies, Wynn and Gettings (1997) have confirmed the volcanic center and that parts of the Tombstone Caldera underlie the eastern margins of Fort Huachuca. The recent geophysical studies conducted by the USGS in the vicinity of Fort Huachuca

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indicate that volcanic features may play an important role in defining the local groundwater system (Wynn and Gettings 1997).

Interpretation of a number of published cross sections, as well as other geologic information, was used to construct the generalized cross-section shown in Figure 3.6-2. This hypothetical cross-section portrays a section of the Sierra Vista Sub-Basin near Charleston.

The majority of the available water in the area is found in a 'regional' aquifer that extends beneath much of the San Pedro basin. In some places, the regional aquifer is disrupted by faulting or other geologic phenomena and groundwater may be found in subregional or local aquifers. Floodplain aquifers are shallow and more directly connected to the surface flow in adjacent streams. Perched aquifers usually represent relatively small volumes of water trapped by impervious layers of rock or sediment. The aquifers receive most of their recharge from the mountain fronts and stream channel and valley floor infiltration. Mountain front recharge consists of surface runoff from impermeable surfaces and steep slopes that flows over and infiltrates into permeable basin fill alluvium that eventually reaches the water table. Stream and valley floor infiltration is related to the percolation of surface water downward through alluvial sediments that eventually reach the water table.

The upper and lower basin fill deposits are a major source of groundwater in the USPB and are referred to as the 'regional aquifer'. About 1,200 square miles (3108 sq. km) of the USPB is covered by basin fill and floodplain alluvium deposits. The lower unit of the basin fill consists of interbedded sandstone and gravel. It ranges in thickness from 250 to 500 feet (75 to 150 m). Typically, the unit consists of interbedded layers of gravel, silt, and other fine-grained sediments; thus exhibiting wide ranges in permeability across the range and depth of the unit. A unit of more recent basin fill overlies the lower unit. This unit consists of sandy, clayey and silty gravel beds originating near the mountain fronts. The perched layers are sufficient to provide water wells with limited yields. Several ranch wells derive water from this source; however, volumetrically, perched water is not a significant regional source of supply.

Groundwater generally occurs under unconfined or water table conditions in most of the aquifer. Groundwater may occur under confined conditions where permeable and saturated alluvium is overlain by impervious silt or clay lenses. The two areas in the USPB where confined conditions in the aquifer exist are the Palominas-Hereford area and the St. David-Benson area (Roeske and Werrel 1973). Another local water table aquifer also exists on the pediment in the Fort Huachuca area (Harshbarger and Associates 1974). Groundwater flow in the unconfined portion of the aquifer is generally from the valley margins near the mountains toward the San Pedro River. Local barriers to flow and centers of groundwater pumping cause exceptions to the general flow direction in some areas.

The floodplain alluvium consists of unconsolidated gravel, sand, and silt derived from erosion of the surrounding pediment gravels, mountains, and hills on either side of the San Pedro River. Floodplain alluvium thickness generally ranges from about 10 to 40 feet (3 to 12 m) to over 100 feet (30 m), and may approach 150 feet (45 m) in places (Roeske and Werrell 1973).

The width of the floodplain alluvium ranges from less than a few hundred yards to several miles. Because of the unconsolidated character of these units and their high permeability, water withdrawn from these aquifers is rapidly replaced through recharge from streamflow during periods of runoff.

The flow of water in the floodplain alluvium is hypothesized to be at an oblique angle to the San Pedro flowing in a northerly direction. The floodplain alluvium is recharged by streamflow, by upward leakage from the underlying confined portion of the regional aquifer, from lateral flow from the regional aquifer, and by deep percolation from farming activities. In the vicinity of the Babocomari River, a large volcanic plug appears to separate the regional aquifer into west and east units. The plug may isolate the west unit from the floodplain aquifer.

The USGS has conducted radionuclide tracer studies which appear to indicate that more water is entering the San Pedro River system from lower elevations and possibly indicates a recharge source closer to the river rather than from the Huachuca Mountains to the west (Pool 1997).

Water-level changes in the floodplain alluvium show seasonal fluctuations. Flood flows recharge the alluvium each summer and winter, often filling the available storage space to capacity. There have been no long-term declines in the water levels of the floodplain alluvium (ADWR 1991).

3.7.2.4 Hydrogeology of the Huachuca Mountains

A hydrogeologic investigation of the Huachuca Mountains in the vicinity of the Fort was conducted by the USGS (Brown, et al. 1966). Most of the geologic information in this section is summarized from that report.

The Huachuca Mountains consist of a faulted complex of granite, carbonate rocks, conglomerate and claystone beds. The thick limestone, dolomite and claystone beds dip 30 to 40 degrees and are highly fractured. The beds are cavernous where water has dissolved carbonate along fractures and bedding planes. Groundwater generally moves downgradient through interconnected fractures and caverns following local topography. Large springs occur in canyons where downgradient flow is interrupted by impermeable rocks such as cemented sandstone, siltstone, mudstone, granite or intrusive dikes.

Groundwater generally flows northeasterly from the east face of the Huachuca Mountains. The San Pedro basin fill units are recharged by infiltration through canyon stream channels where runoff from side slopes collects and on alluvial fan slopes along the mountain front. Although some of the storm runoff recharges the groundwater basin, most of the infiltrated water is eventually lost to transpiration. Springs in the Huachuca Mountains are recharged by infiltrating water that is captured by fractures in the carbonate rocks.

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indicate that volcanic features may play an important role in defining the local groundwater system (Wynn and Gettings 1997).

Interpretation of a number of published cross sections, as well as other geologic information, was used to construct the generalized cross-section shown in Figure 3.6-2. This hypothetical cross-section portrays a section of the Sierra Vista Sub-Basin near Charleston.

The majority of the available water in the area is found in a 'regional' aquifer that extends beneath much of the San Pedro basin. In some places, the regional aquifer is disrupted by faulting or other geologic phenomena and groundwater may be found in subregional or local aquifers. Floodplain aquifers are shallow and more directly connected to the surface flow in adjacent streams. Perched aquifers usually represent relatively small volumes of water trapped by impervious layers of rock or sediment. The aquifers receive most of their recharge from the mountain fronts and stream channel and valley floor infiltration. Mountain front recharge consists of surface runoff from impermeable surfaces and steep slopes that flows over and infiltrates into permeable basin fill alluvium that eventually reaches the water table. Stream and valley floor infiltration is related to the percolation of surface water downward through alluvial sediments that eventually reach the water table.

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The floodplain alluvium consists of unconsolidated gravel, sand, and silt derived from erosion of the surrounding pediment gravels, mountains, and hills on either side of the San Pedro River. Floodplain

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alluvium thickness generally ranges from about 10 to 40 feet (3 to 12 m) to over 100 feet (30 m), and may approach 150 feet (45 m) in places (Roeske and Werrell 1973).

The width of the floodplain alluvium ranges from less than a few hundred yards to several miles. Because of the unconsolidated character of these units and their high permeability, water withdrawn from these aquifers is rapidly replaced through recharge from streamflow during periods of runoff.

The flow of water in the floodplain alluvium is hypothesized to be at an oblique angle to the San Pedro flowing in a northerly direction. The floodplain alluvium is recharged by streamflow, by upward leakage from the underlying confined portion of the regional aquifer, from lateral flow from the regional aquifer, and by deep percolation from farming activities. In the vicinity of the Babocomari River, a large volcanic plug appears to separate the regional aquifer into west and east units. The plug may isolate the west unit from the floodplain aquifer.

The USGS has conducted radionuclide tracer studies which appear to indicate that more water is entering the San Pedro River system from lower elevations and possibly indicates a recharge source closer to the river rather than from the Huachuca Mountains to the west (Pool 1997).

Water-level changes in the floodplain alluvium show seasonal fluctuations. Flood flows recharge the alluvium each summer and winter, often filling the available storage space to capacity. There have been no long-term declines in the water levels of the floodplain alluvium (ADWR 1991).

3.7.2.4 Hydrogeology of the Huachuca Mountains

A hydrogeologic investigation of the Huachuca Mountains in the vicinity of the Fort was conducted by the USGS (Brown, et al. 1966). Most of the geologic information in this section is summarized from that report.

The Huachuca Mountains consist of a faulted complex of granite, carbonate rocks, conglomerate and claystone beds. The thick limestone, dolomite and claystone beds dip 30 to 40 degrees and are highly fractured. The beds are cavernous where water has dissolved carbonate along fractures and bedding planes. Groundwater generally moves downgradient through interconnected fractures and caverns following local topography. Large springs occur in canyons where downgradient flow is interrupted by impermeable rocks such as cemented sandstone, siltstone, mudstone, granite or intrusive dikes.

Groundwater generally flows northeasterly from the east face of the Huachuca Mountains. The San Pedro basin fill units are recharged by infiltration through canyon stream channels where runoff from side slopes collects and on alluvial fan slopes along the mountain front. Although some of the storm runoff recharges the groundwater basin, most of the infiltrated water is eventually lost to transpiration. Springs in the Huachuca Mountains are recharged by infiltrating water that is captured by fractures in the carbonate rocks.

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Besides the regional aquifer, a local perched aquifer exists along the pediment of the Huachuca Mountains in a zone where the alluvium of the basin fill is underlain at shallow depths by bedrock. The perched aquifer extends from the area of Carr Canyon toward the Fort Huachuca military reservation boundary and extends northeasterly toward the San Pedro River (Harshbarger and Associates 1974). Brown et al. (1966) suggest that a bedrock ridge or northeastward-trending "nose" of low permeability rock may cause a steep north-dipping configuration of the water table southeast of the Fort and north of Garden Canyon.

3.7.2.5 Water Quality

Surface water derived from the San Pedro and Babocomari Rivers is considered of relatively good quality (BLM 1989). Water quality in the San Pedro River has been monitored for decades by a number of state and federal agencies. Pollutant releases have historically occurred when intense rainstorms cause failure, breach, or emergency release from holding ponds, sewage lagoons, and tailings dams. On occasion, sewage or mining wastes not associated with the installation have been intentionally or accidentally released, usually to create additional storage capacity. Such events have significant impact on downstream water quality and have historically harmed downstream uses and users of San Pedro River water.

Generally, the chemical quality of the groundwater obtained by Fort Huachuca and other users in the USPB is good and is considered suitable for domestic uses. However, in several areas (St. David and Benson), fluoride and sulfate concentrations at or above drinking water standards have been noted. The chemical quality of water withdrawn from the floodplain aquifer is good and considered suitable for most uses, although there may be areas with elevated readings of fluoride and sulfate. Groundwater on the installation is treated with chlorine. No other treatment is required.

3.7.3 Water Use And Management

This section describes the water supply, use and water demand for the Fort Huachuca/Sierra Vista area including trends and projections.

3.7.3.1 Water Supply and Use

Sierra Vista and Huachuca City depend entirely on groundwater (ADWR 1990). The municipal water wells servicing these population centers are located within six miles of Fort Huachuca. All have depths exceeding 800 feet 240 m). Most have pumping capacities exceeding 500 gallons per minutes (gpm). The municipal wells are typically pumped at a high continuous rate throughout the peak demand period.

There are more than 80 registered wells in the two townships adjacent to Fort Huachuca (ADWR 1995). Of these, 30 are high-capacity wells tapping the regional aquifer, with pumping capacities exceeding 100

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gpm, and well depths exceeding 400 feet (120 m). Fifteen of these wells are categorized as municipal water supply wells. Ten are categorized as agricultural or industrial water supply wells. The uses of the remaining five are unidentified. These wells are part of the well field of more than 46 high-capacity wells on or within six miles of Fort Huachuca. The privately owned wells, which are not the installation's well fields, have a combined pumping capacity exceeding 18,000 gpm.

Water consumption at the installation has steadily decreased as a result of the use of treated effluent for irrigation, an aggressive water conservation program, and the net decrease in Fort Huachuca personnel. Fort Huachuca uses effluent to irrigate the Chaffee Parade Field, the golf course, and the new outdoor sports complex. During 1997, Fort Huachuca produced approximately 1300 ac-ft of treated effluent.

Fort Huachuca predates most development in the USPB. The installation has some of the oldest reserved surface water claims in the State of Arizona. Most on-post surface water features are ephemeral, fed only through snowmelt and runoff from the Huachuca Mountains. Under current conditions, there are few exploitable surface water supplies on Fort Huachuca. Almost all on-post water uses are met by a series of groundwater wells.

Local surface water is generated as storm runoff, snowmelt, and discharge from springs into the stream channels of Garden and Huachuca Canyons. Other canyons located within the boundaries of Fort Huachuca yield little water except for short durations after precipitation events. Springs were at one time the sole source of water for Fort Huachuca. By 1983, Fort Huachuca no longer used springs as a source of potable water.

Groundwater is the source of Fort Huachuca's potable water supply. The total quantity of groundwater pumped by the post in 1996 was 2,355 ac-ft, and 2,357 acre-ft in 1997. Eight wells on Fort Huachuca are considered municipal water supply wells with well depths between 710 and 1230 feet. Two of the wells (800 gpm pump capacity) are located on the East Range and six wells (500-700 gpm pump capacity) are located on post between the main gate and the east gate. Another five wells support military testing and research activities across the post and have minimal production. . Total annual pumpage data comes from metering at the wellhead. Detailed usage information to distinguish residential use from military or US Forest Service use is not currently available.

3.7.3.2 Recent Water Use Reductions

Recent trends in Fort Huachuca water use data show a declining impact to the Sierra Vista subwatershed. The installation's withdrawals have steadily decreased (Table 3.7-1).

Due to conservation and reuse efforts, and in the context of the anticipated personnel decreases, the net reduction in the installation's withdrawal of water from the local aquifer system is anticipated to continue.

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From the most recent high annual Fort Huachuca withdrawals of 3,200 ac-ft occurring in 1988 and 1989, Fort Huachuca has reduced its annual withdrawal 850 ac-ft to 2,357 ac-ft in 1997 (Table 3.7-1).

Table 3.7-1. Fort Huachuca Population and Water Use (Pumpage) History (Population Data is from 30 September of Each Year)

Year	Military Assigned	Employees[1]	Military Family Members Residing on Post	Water Use In Acre Feet
1997	5,703	4,413	4,734	2,357
1996	5,670	4,613	5,027	2,355
1995	5,854	5,010	4,978	2,428
1994	7,533	5,779	5,108	2,568
1993	5,823	5,430	4,930	3,028
1992	5,682	5,944	4,760	2,846
1991	5,914	5,506	4,775	2,709
1990	6,448	5,671	4,897	2,747
1989	6,440	5,802	4,891	3,207

Source: ENRD 1997d
[1]Represents DoD civilian workers and non-DoD civilian workers on Fort Huachuca.

3.7.3.3 Population and Water Demand

Regional water demand can be estimated using an equation combining population and per capita water delivery rates. These calculations are rough, having a statistical error of at least 10 percent. In most instances, these figures are adequate for general planning purposes. However, an error of 10 percent, in either regional population or per capita demand, is approximately equivalent to adding or subtracting a population the size of Fort Huachuca.

3.7.3.4 Regional Water Demand Projections

The collective impact of the well field has been numerically modeled in the ADWR groundwater model for the USPB (ADWR 1988; revised 1995). ADWR prepared estimates of municipal groundwater withdrawals for their 1988 groundwater impact model. Calculations were based on consumptive use figures from the 1980 census, as well as on a population study of the USPB conducted by the ADWR Hydrology Division. Pumpage was distributed according to projected population data, water company service areas, and irrigated acreage (ADWR 1988).

The model projected consumptive use for all water companies and municipalities whose franchise areas served urban populations within the model boundaries. The study area included the City of Sierra Vista, Huachuca City, and Fort Huachuca. An urban population of 26,598 persons using 6,057,239 gallons per day (gpd) was used to project a consumptive use of 228 gallons per person per day (gppd) for the base year 1980. Water demand for the following years was then calculated based on changing population and static consumptive use. Population was projected at 56,275 persons for the base year 2000, 79,820 persons were projected for the year 2015, and 105,660 persons were projected for the year 2035.

A special census of the City of Sierra Vista was conducted in 1985 by ADES after ADWR had completed its own population study for the USPB. ADWR assumed the results of the special census did not impact the groundwater consumptive use model, as figures used to calibrate the model were based on the 1980 census (ADWR 1988). According to the special census, the population of Sierra Vista alone will approach 54,625 persons by the year 2000. This estimate is 1,200 persons more than projected for the same base year in the ADWR model (ADWR 1988). This would increase groundwater withdrawals by about 330 ac-ft per year by the year 2000. According to ADWR, this resulted in less than a two percent correction in the original projections, and was considered to fall within the calculated margin of error for the model.

The ADWR has recently revised Sierra Vista population projections and rerun the water demand model (Putman 1995). The new demographic model predicts a population of 55,971 persons for the years 2000, 62,169 for 2010, and 69,420 for 2025. Projected water demand for each of the sub-populations within the Sierra Vista subwatershed is shown in Figure 3.7-2. Based on projected populations, water demand will increase from about 17,900 ac-ft/yr. to 25,000 ac-ft/yr. in the Sierra Vista subwatershed.

3.7.3.5 Fort Huachuca Water Demand Projections

The Army uses effective population for planning water demand and wastewater requirements. Effective population accounts for personnel who are on and off-post residents as well as their dependents. Estimates of effective population are shown in Table 3.7-2. A range of possible populations was examined, including the long-range effective population and several incremental population values from 0 to 25,000. Demand was calculated using the formula in the Master Plan (Zillgens 1991a). Domestic demand represents water that is used and returned for waste treatment and total demand is all the water pumped and used by the installation, including irrigation and other consumptive uses. The projected total water demand for the long-range effective population at Fort Huachuca was calculated to be 2,514 ac-ft/yr. This estimate compares favorably with the actual pumpage figure for 1997 (2,357 ac-ft/yr.) measured by Fort Huachuca staff. Increases and decreases in actual population on the installation would raise or lower water demand in a linear fashion.

Table 3.7-2. Fort Huachuca Effective Population For 1996

	Total Number of Persons	Factor	Effective Population
Military Living On-Post	3,629	1.00	3,629
Dependents Living On-Post	5,027	1.00	5,027
Military Living Off-Post	2,041	0.33	674
Civilian Employees and Contractors	4,613	0.33	1,523
Totals	**15,310**		**10,853**

Source: Nakata 1997

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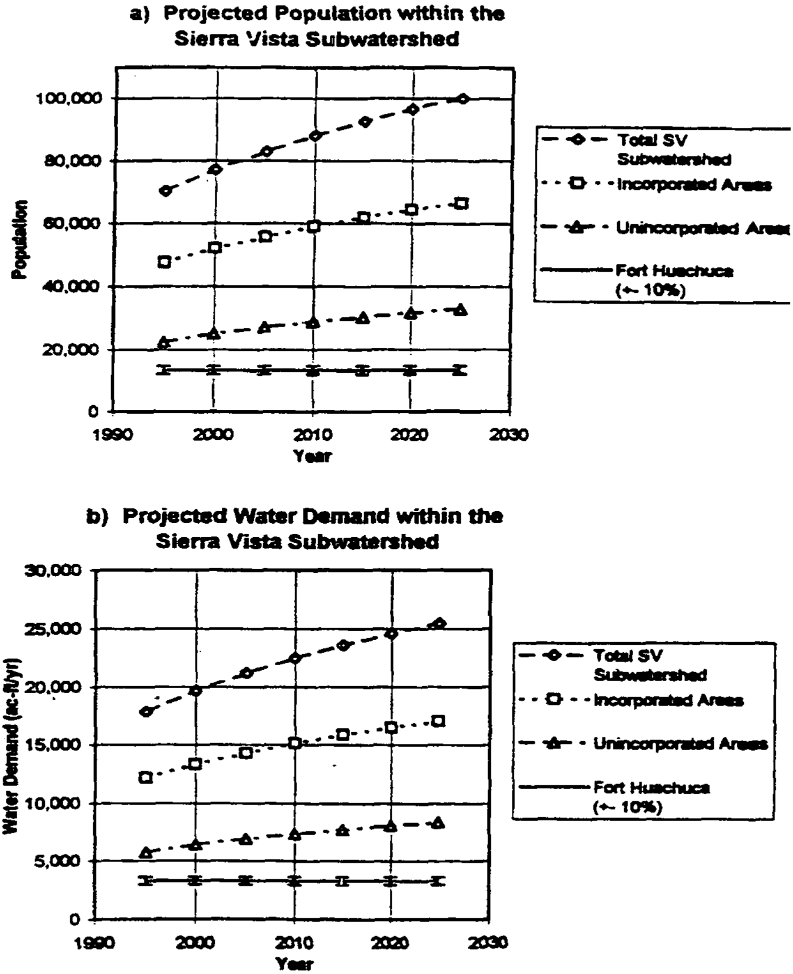

FIGURE 3.7-2 Projected Population and Water Demand within Sierra Vista Subwatershed (ADWR 1996)

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3.7.3.6 Hydrogeologic and Surface Water Studies

While the existence and historical cause of the cone of depression in the Sierra Vista Subwatershed are generally agreed upon in the literature, there has been considerable speculation regarding the affect of groundwater use at Fort Huachuca on baseflow that sustains surface flow of the San Pedro River in the SPRNCA.

Historically, the models applied to regional groundwater conditions have assumed that groundwater in the USPB is contained in one large, continuous regional aquifer and a floodplain aquifer beneath the SPRNCA (ADWR 1988, 1991; Vionnet and Maddock 1992). Recent geophysical studies suggest that the assumption of one large, continuous regional aquifer may not be accurate. Preliminary findings suggest at least some natural isolation between the Fort Huachuca recharge areas and nearby parts of the San Pedro River (Wynn and Gettings 1997).

Groundwater conditions in the Sierra Vista subwatershed were modeled by ADWR in 1988 and updated in 1991. Based on the assumption of one large continuous regional aquifer, the hydrologic model indicates that no effects on surface water flows in the San Pedro River have been observed to date resulting from groundwater use at Fort Huachuca (ADWR 1988, 1991). This finding was later supported by Putman (1996).

The ADWR (1991) report indicates that "the cone of depression in the Sierra Vista/Fort Huachuca area has not intercepted the river" (ADWR 1991, p.495) and while the report suggests that a certain amount of groundwater flow towards the river in the regional aquifer is being diverted into the cone of depression, it concludes that "fifty years into the future, the Sierra Vista/Fort Huachuca cone of depression [will still] not intercept the river" (ADWR 1991, p.495).

The ADWR (1991) model projects effects to the SPRNCA possibly occurring by the year 2038. It projects a possible decrease of 0.7 cfs in water available to the river in the reach between Charleston and the mouth of the Babocomari River by the year 2038 and that continued groundwater withdrawals from the Fort Huachuca - Sierra Vista well fields at 1991 pumpage levels may eventually affect surface water flows in the San Pedro River as the cone of depression increases (ADWR 1991).

In another study, the University of Arizona San Pedro Interdisciplinary Study Team concluded that pumping from the regional aquifer is not a major factor imperiling streamflow in the San Pedro River, and that drought-related reductions in surface runoff and irrigation-related pumping from the floodplain aquifer are much stronger influences (Maddock 1994).

A recent ADWR report (Correll et al. 1996a) documents construction of a model of the USPB and calibrates both steady state and transient models. The model is regional in scope and extent and was not intended to evaluate site-specific problems. The model is intended as a planning tool to evaluate impacts

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of various groundwater management and conservation scenarios. According to the model report, the major change in the San Pedro River and the associated groundwater system over the past 50 years has been a decrease in groundwater discharge to the river between the years 1935 to 1940 and 1951 to 1956 (Correll et al. 1996a). The model report indicates that average baseflows have decreased through time from 1951 to 1980. However, the report also states that there may have been an increase in average baseflows for the period 1981 to 1990 (Correll et al. 1996a).

In a supplement to Correll et al. (1996a), the ADWR also modeled several groundwater flow scenarios of future groundwater and surface water conditions in the Sierra Vista Subwatershed. The model (Correll et al.1996b) was used to evaluate the effects from several water management options on the groundwater system between the years 1990 and 2030. An initial baseline scenario (Scenario 0) simulated groundwater pumping conditions at 1990 levels and the phasing out of agricultural pumpage in the Palominas/Hereford area by the year 2000. Scenario 1.1 simulated changes in groundwater pumpage based on population projections, effluent recharge from the Sierra Vista and Fort Huachuca wastewater treatment plants, and no agricultural pumpage after the year 2000. Scenario 1.2 was similar to Scenario 1.1 except agricultural pumpage continues throughout the simulation period. Scenario 2 simulates increases in groundwater pumping based on lower population projections that Scenario 1, effluent recharge from the Sierra Vista and Fort Huachuca waste water treatment plants, and no agricultural pumpage after 2000. Scenario 3 simulated increases in groundwater pumpage based on higher population projections than in Scenario 1, no effluent recharge, increased evapotranspiration, and no agricultural pumpage after 2000.

The results of the Correll (1996b) model indicate that agricultural pumpage had the greatest impact on percent changes in baseflow at Charleston, followed by effluent recharge. Baseflow increased under most scenarios. Percent changes in baseflow from 1990 levels at Charleston were an increase of 19% for the baseline scenario, an increase of 30% for Scenario 1.1, no change for Scenario 1.2, an increase of 30% for Scenario 2, and a decease of 5% for Scenario 3.

Another recent hydrologic analysis has been conducted by Sharma et al. (1997). This study analyzed stream flow and groundwater data collected by the BLM on the San Pedro and Babocomari Rivers. The purpose of the study was to establish a more efficient monitoring program for the SPRNCA. All of the stream discharge data and some of the groundwater level data were collected at non-systematic intervals, and the stream flow measurements may not have been collected at the same location at each site over time. The authors reached qualitative conclusions and suggested that the amount of groundwater entering certain stream reaches had diminished over the period of record (1987-1995) but indicated that their analysis was made difficult by inadequate documentation, inconsistent procedures and malfunctioning equipment. The authors made numerous suggestions to improve the monitoring program.

The modeling efforts discussed above represent the most probable impacts on the rivers based on the assumption that the groundwater is contained within one large, regional continuous aquifer. For many years it was assumed that Fort Huachuca and the adjacent communities draw groundwater from the same aquifer that provides baseflow to the San Pedro River and sustains the downstream riparian habitat. Because of this assumed aquifer continuity, actions at Fort Huachuca were assumed to have the potential to affect regional water and riparian resources. Recent geophysical research, however, indicates that this view may be simplistic. Recent geophysical research is providing a clearer understanding of the relationship between the regional aquifer and the San Pedro River.

Two research efforts are currently underway at the USGS. One study (Wynn and Gettings 1997) utilizes electromagnetic geophysical data to determine the depth to groundwater and the locations of impermeable barriers. The other study (Pool 1997) uses radionuclide tracer studies to identify water sources of the San Pedro River.

Wynn and Gettings (1997) find preliminary evidence that suggests the existence of a shallow depth conductor and an intermediate depth conductor that underlies the shallow conductor. They report that based on drilling and ground geophysical surveys this intermediate conductor appears to be a clay body that may influence flows near the shallow aquifer between Fort Huachuca and the San Pedro River (Wynn and Gettings 1997). They conclude that while it remains unclear from these limited data how this structure affects water movement in the aquifer, isotopic evidence reported elsewhere, and the appearance of the intermediate conductor both suggest that there may be some natural isolation between the recharge areas west of Fort Huachuca and much of the San Pedro River in the surveyed area (Wynn and Gettings 1997). The study cites that if this natural isolation exists, then much if not most of the water in the SPRNCA must derive from the upper reaches of the San Pedro River drainage in Mexico (Wynn and Gettings 1997). Geophysical studies confirm the presence of a volcanic body at the approximate confluence of the Babocomari and San Pedro Rivers.

Moore (1993) identified a volcanic center and parts of the Tombstone Caldera that underlie the eastern margins of Fort Huachuca. The Wynn and Gettings (1997) report delineated the volcanic center and part of this caldera. The recent geophysical studies conducted by the USGS in the vicinity of Fort Huachuca indicate that volcanic features may play an important role in defining the local groundwater system (Wynn and Gettings 1997).

Wynn and Gettings (1997) report a pronounced increase in the water table on the eastern side of the cone of depression that appears to be from substantial surface recharge. Based on records of effluent volumes and estimates of evapotranspiration, as well as discussions with and a site inspection by the U.S. Water Conservation Laboratory, the amount of recharge has been estimated to be between 400 and 700 ac-ft per year (Kent 1997). The potential source of this recharge for the aquifer underlying the Fort Huachuca well field is infiltration and deep percolation from the Fort's treated effluent ponds located on the western edge of the East Range.

The other USGS study (Pool 1997) has conducted radionuclide tracer studies which indicate that more water is entering the San Pedro River system from lower elevations and possibly indicates a recharge source closer to the river rather than from the Huachuca Mountains to the west (Pool 1997). One reasonable interpretation of this data is that surface flow in the San Pedro River is more dependant on water recharge from east of the SPRNCA from the Mule Mountains than from the Huachuca Mountains. This finding supports the Wynn and Gettings (1997) study that suggests at least some natural isolation between the recharge areas west of Fort Huachuca and much of the San Pedro River.

Changes in floodplain vegetation and erosion have also been studied to determine potential correlation with surface flow variability. Hereford (1993) and Geraghty and Miller (1995) recently analyzed historical flows and conditions in the San Pedro River. They found that historical flows and conditions have undergone significant changes. Historically, the river was incised and meandered through marshy areas and beaver ponds. Lush grasslands surrounded the river and upland areas, and large woody vegetation was sparse or non-existent. Today the river is entrenched onto the floodplain and lined with a riparian forest.

The establishment of riparian vegetation in the 1930s has significantly increased the evapotranspiration rates along the San Pedro River. (Evapotranspiration refers to the loss of water from the soil by evaporation and transpiration from the plants growing thereon.) This establishment of vegetative growth has resulted in further seasonal water losses as well as long-term declines in baseflow. The establishment of the riparian corridor in the 1930s correlates well with the beginning of the systematic decline in river baseflow (Geraghty and Miller 1995). Recent evapotranspiration estimates also support this position. Qi et al. (1998) estimate total water loss from the riparian corridor along the San Pedro River to be approximately 48,270 tons per day. These values would be equivalent to 176 thousand gpd per hectare evaporated from cottonwood, mesquites, and sacaton grass vegetation along the riparian corridor. The daily evaporative water loss for the entire riparian corridor was estimated to be approximately 10 million gallons, or 30.7 ac-ft per day (Qi et al.1998).

A comprehensive analysis of river baseflow data was compiled for the Charleston gauging station by Hereford (1993). Low flow analysis of daily mean discharges show that low flows substantially decreased from 1905 to 1928, followed by an increase in 1929-1930. From 1930 to the present day, low flows have generally declined.

The direct and indirect effects of pumping in the regional aquifer, including the impact of the cone of depression in the Fort Huachuca and Sierra Vista area, on baseflow of the San Pedro River are not clear. For instance, widespread use of wells in the San Pedro Valley only began in the 1940s while baseflow has been declining steadily since 1930 (Geraghty and Miller 1995). Also, groundwater pumping from agricultural wells along a 20-mile stretch of the river was suspected to have turned some stretches of the river from perennial to intermittent and even ephemeral. However, after more than eight years since these lands were "retired" from agricultural use, only one mile of the river is more perennial than before (Geraghty and Miller 1995).

In addition to factors such as pumping, changes in vegetation and evapotranspiration rates and natural variability in precipitation and recharges, groundwater conditions affecting baseflow can be altered by geomorphological processes. Historic evidence suggests that entrenchment of the San Pedro River up to 30 feet may have occurred with a consequent lowering of the water table adjacent to the river by the same 30 feet (Geraghty and Miller 1995). Geraghty and Miller (1995) conclude that the observed long-term *water level declines in wells near the river may reflect this occurrence.*

In December 1997 and February 1998, Dr. Robert MacNish, adjunct professor at the University of Arizona, gave brief public presentations on his recent conclusions about the status of the cone of depression in the Sierra Vista area. Dr. MacNish indicated in these presentations that based on new data from the Lewis Springs area, that the cone of depression may already be influencing the baseflow of the *San Pedro river. The data sets and report have not yet been made available in written form, or for peer* review, as of the date of this EIS. The presentation did not show analysis of the increase in vegetation along the corridor, the below average rainfall recorded in the area during the 1994 through 1997 period, or other influences on baseflow. Statistical confidence intervals, means, standard deviations and other standard treatments in mathematical data analysis were not included in the presentations. Analysis methodologies, and number and statistical accuracy of data points used for the pre-development baseline water contours were not provided, and insight into other analytical treatment was not provided. Because information and data from these presentations are not available in writing for scientific review they are not included in this analysis.

3.8 BIOLOGICAL RESOURCES

This section discusses biological resources at Fort Huachuca and the adjacent region. The presence of the installation has protected and preserved many biologically important habitats that may otherwise have been affected by other land use. Fort Huachuca provides an important corridor and refuge for animals dwelling in, or moving through, these habitats. In recent years, the Army has actively worked to further improve the installation's environment and to reduce or mitigate the effects of some of its activities. Fort Huachuca has invested significant resources to conserve water, protect or improve habitat, reduce erosion, and monitor land conditions and trends.

The region of influence for biological resources includes Fort Huachuca and the adjacent region. The geographic boundaries of the region of influence (the primary study area) include the installation and the

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adjacent environs including portions of the SPRNCA. Information on the study area was obtained from environmental documents and reports as well as personal contact with the AGFD, the Fort Huachuca biologist, and other ecologists. Ongoing biological studies for Fort Huachuca were conducted during development of this EIS.

3.8.1 Terrestrial Habitat

Vegetation in the general region of influence is characterized as part of the Mexican Highland Shrub Steppe Province which encompasses about 17,500 square miles (45,325 sq. km) and represents about 0.6 percent of the U.S. (Brown 1982). This area is also classified as the Chihuahuan Province with Madrean Province inclusions (Brown 1982). Plant species composition and vegetation productivity are largely determined by rainfall distribution as influenced by topography. At lower elevations within the USPB, xerophytic shrubs and grasses provide sparse vegetative cover. On the moister mountain slopes (e.g., Huachuca Mountains) stands of trees and shrubs predominate.

3.8.1.1 Regional Area Setting

Fort Huachuca's boundaries cut across and include several plant communities, or habitat types. These habitats extend into adjacent land units including the Coronado National Forest, the SPRNCA, The Nature Conservancy Ramsey Canyon Preserve, other federal and state lands, and municipal and private property. Several mountain ranges are in the area including the Dragoons to the northeast, the Whetstones to the north, the Huachucas to the west, the Mules to the east, and Canelo Hills on the west side of the Huachucas north of San Rafael Valley. The installation provides a corridor for animals dwelling in or moving through these habitats.

A total of 21 plant associations were identified within the SPRNCA and immediately surrounding areas. Associations included grasslands, mixed shrub, riparian, and wetlands. Grassland associations included tobosa-mixed shrub and sacaton. Mixed shrub associations include vegetation dominated mesquite, tarbush, acacias, creosote bush, rabbitbrush, and fourwing saltbush. Riparian associations included willow-cottonwood and salt cedar associations. Wetland vegetation included rushes, sedges, cattails, and saltgrass.

The SPRNCA is also within the region of influence. In 1989 the BLM prepared the San Pedro River Riparian Management Plan and EIS. This report addressed many of the habitat issues affecting the USPB from the U.S.-Mexican border to the town of St. David. Current land use of the SPRNCA includes habitat protection, recreation, and rights-of-way. Fort Huachuca shares a common border (about 7 miles long) and consequently some common habitat with the SPRNCA along the eastern boundary of the East Range.

3.8.1.2 Fort Huachuca

Six upland vegetation types are found within Fort Huachuca and the region of influence (Brown 1982). These include desertlands, grasslands, forest, and woodland formations types (Figure 3.8-1). In addition, three wetland/riparian communities are present on the installation. The following are general descriptions of each vegetation type. These descriptions are based on information contained in Brown (1982), the Integrated Natural Resources Management Plan (INRMP) (ENRD 1995, Taylor 1995a), and the Fort Huachuca Master Plan (Zillgens 1991a).

Chihuahuan desertscrub vegetation covers approximately 19,000 acres (30 sq. mi.) on Fort Huachuca. It is the predominant vegetation on the East Range. This vegetation is primarily found on gravelly and limestone soils and typically occurs between 3,900 and 4,400 feet (1170 and 1320 m) above sea level (ASL). This vegetation type is adjacent to semidesert grasslands and has been expanding and replacing grasslands (Brown 1982). Vegetation is shrub-dominated. Over 1,000 plant species have been identified, therefore vegetation can vary from site to site (Brown 1982). Based on NRCS soil surveys, annual production ranges between 500 and 1,200 pounds per acres (lbs/ac) depending on seasonal climactic conditions (NRCS 1997). Since 1962, when the Army fenced the East Range, range conditions have been improving, but bushy and non-native species have largely replaced the natural desert grasslands. Chihuahuan desertscrub common vegetation is as follows:

- Grasses: dropseeds, grama grasses, tobosa grass, and Indian ricegrass
- Shrubs: creosote bush, mesquite, desert broom, whitethorn acacia, other acacias, ephedra, ocotillo, saltbush, lotebush, and condalia
- Succulents: Agaves and yucca

Wildlife species likely to occur in Chihuahuan desertscrub habitat include reptiles such as desert spiny lizard and Texas horned lizard; mammals such as Harris' antelope squirrel, desert cottontail, and black-tailed jack rabbit; and birds such as cactus wren and curve-billed thrasher. Chihuahuan desertscrub is a relatively young ecosystem, and as a result there are few warm-blooded vertebrate populations restricted to it. However, many reptile populations (e.g., reticulated gecko and great earless lizard) are restricted or at least centered in it.

Plains, Great Basin, and semidesert grasslands occur from about 4,400 to above 5,100 feet (1320 to 1530 m) elevation and cover 29,000 acres (45 sq. mi.) of the installation. These vegetation types are found principally on both the West and South Ranges. Animal species in the grassland vegetation types are diverse. These grasslands are important hunting grounds for raptors from the common red-tailed hawk to less common prairie falcons. Western diamondback rattlesnakes and western box turtle are reptiles found in the area. Pronghorn antelope and javelina are regular inhabitants, while the endangered lesser long-nosed bat forages on the grassland agaves for only four months out of the year.

Historically the vegetation was grass dominated with some shrub encroachment from drainages. Because of fire suppression and grazing practices throughout the range of this vegetation type, shrubs are more prevalent in current vegetation and may dominate in some locations. Based on NRCS soil surveys, annual

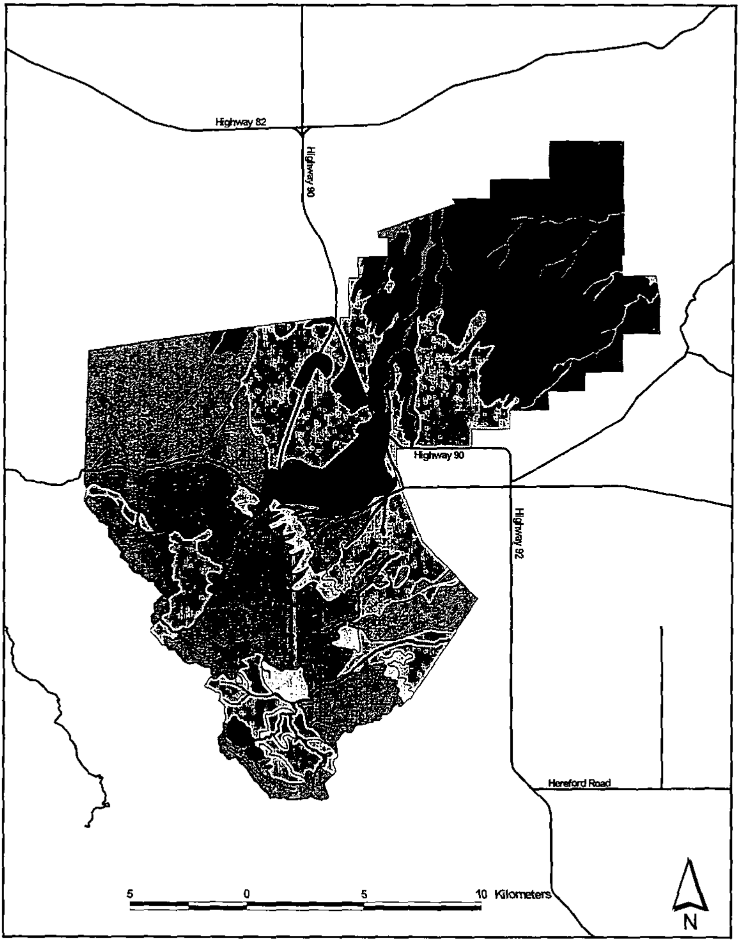

FIGURE 3.8-1

**Fort Huachuca:
Vegetation**

SOURCE: Fort Huachuca, Wildlife Office, 1998

Vegetation
- Deciduous Woodland
- Mahogany Woodland
- Mesquite Woodland
- Mesquite-Grass Savanna
- Mixed Woodland
- Oak Woodland
- Oak-Grass Savanna
- Open Grassland
- Pine Woodland
- Pinyon-Juniper Woodland
- Shrub-Grassland
- Shrubland
- Urban and Built-Up Land

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production ranges between 800 and 1,700 lbs/ac depending on seasonal climactic conditions (NRCS 1997). Plains and Great Basin grassland common vegetation is as follows:

- Grasses: gramagrasses, buffalograss, Indian ricegrass, dropseed, galleta grass, and lovegrass
- Shrubs: saltbush, winterfat, rabbitbrush, and snakeweed

The Semidesert grassland vegetation type shares characteristics of both plains grasslands and Chihuahuan desertscrub. The vegetation has a large grass component similar to plains grasslands and a diverse shrub structure similar to Chihuahuan desertscrub. The structural variation resulting from the increased vegetative diversity supports avian species (e.g., Swainson's hawk and scaled quail) as well as small mammals (e.g., black-tailed jack rabbit and spotted ground squirrel). Based on NRCS soil surveys, annual production ranges between 100 and 2,500 lbs/ac depending on seasonal climactic conditions (NRCS 1997). Typical semidesert grassland vegetation is as follows:

- Grasses: blackgrama, tobosa, gramagrasses, muhly, threeawn, and tridens
- Shrubs: rabbit brush, mesquite, lotebush, allthorn, acacias, ocotillo, tarbush, creosote bush, and snakeweed
- Succulents: agaves, yuccas, sotol; cactuses, cholla, prickly pear, pincushion, and hedgehog

The Madrean evergreen woodland (including oak-grass savannah vegetation) begins at about 5,100 feet (1530 m) and continues up to about 6,600 feet (1980 m) in elevation, and covers about 18,658 acres (29 sq. mi.) of the installation. This vegetation type evolved with fire and has a savannah character at lower elevations (oak-grass savannah), which develops into a true woodland at higher elevations. This ecosystem lends itself to a rich assortment of birds and is the principal biotic community for the white-tailed deer. Wildlife species commonly occurring include Arizona gray squirrel, gray-breasted jay, and striped skunk. Less common species include coatimundi, the rare Huachuca black-headed snake, and the threatened Mexican spotted owl. Tree canopy cover in the savannah portions is less than 15 percent and canopy cover in the woodlands ranges between 25 and 50 percent. Based on NRCS soil surveys, annual production ranges between 400 and 850 lbs/ac depending on seasonal climactic conditions (NRCS 1997). Madrean evergreen woodland and oak-grass savannah common vegetation is as follows:

- Grasses: gramagrasses, lovegrasses, junegrass, and ricegrass
- Shrubs: sacahuista, manzanita, sumacs, and silktassel
- Succulents: yucca, sotol, agave, and prickley pear
- Trees: Arizona white oak, Emory oak, and alligator juniper

The Pinyon-Juniper vegetative community occurs in the higher elevations between 6,600 and 7,200 feet (1980 and 2160 m) and covers 2,087 acres (3 sq. mi.) of the installation. Pinyon-juniper is a discontinuous series of habitat islands within these elevations. Large mammals such as black bear and white-tailed deer occur in pinyon woodlands, and raptors such as Northern goshawk and golden eagles nest in higher

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elevations. Game birds such as turkey and Montezuma quail are also residents. Fire suppression has greatly increased canopy cover in these areas, thereby increasing the possibility of catastrophic fire. Based on NRCS soil surveys, annual production ranges between 700 and 900 lbs/ac depending on seasonal climactic conditions (NRCS 1997). Pinyon-juniper common trees are junipers, pines, oaks, and mountain mahogany

The Madrean Montane conifer forest occurs between 6,000 and 8,600 feet (1800 and 2580 m) in elevation and covers about 3,931 acres (6 sq. mi.) of the installation. The vegetation type at the installation's higher elevations was extensively logged and burned in the 19th century. These disturbances increased the incidence of oaks, Mexican pinyon, and alligator juniper and reduced ponderosa pine. This vegetation provides habitat for Mexican spotted owl, and tiger salamander. A variety of other owls, nuthatches, and juncos also reside here, and Steller's jays and hairy woodpecker are common. Mammals range from the small (e.g., Bailey pocket gopher) to the large (e.g., mountain lion). This vegetation tree canopy cover ranges form 30 to 50 percent on ponderosa pine sites and 50 to 70 percent on Douglas fir sites. Based on NRCS soil surveys, annual production ranges between 200 and 300 lbs/ac depending on seasonal climactic conditions (NRCS 1997). Madrean Montane conifer common vegetation is as follows:

- Grasses: gramas, muhlys, junegrass, bromes, and dropseeds
- Shrubs: buckbrush, New Mexico locust, leadberry, snowberry, and mountain mahogany
- Trees: Ponderosa pine Chiricahua and Apache pines, Douglas fir, Mexican white pine, and quaking aspen juniper, pinyon, madrone, and Gambel oak

Caves and abandoned mines provide essential habitats for active or hibernating bats (e.g., the endangered lesser long-nosed bat) other small mammals, reptiles, amphibians, and invertebrates (e.g., the Arizona cave amphipod, a federal candidate species). The installation protects these sites and limits access by gating the entrances, fencing off the entrance or by limiting release of location information.

3.8.2 Aquatic Habitat

The riparian zone of a stream includes the stream channel, left and right stream banks, and floodplain (Platts et al. 1983). This includes the area of transition between aquatic and terrestrial habitats and communities. A rich variety of wildlife is found in riparian habitat. The variety of species supported by riparian habitats provides good foraging and hunting opportunities for the raccoon and bobcat. Most frogs, toads, and salamanders are dependent on riparian habitats for at least a portion of their life cycle. Riparian vegetation provides cover and food for fish, helps stabilize stream banks, and intercepts and stores solar radiation (Platts et al. 1987). It also provides travel corridors for many wildlife species due to the enhanced cover that provides protection from predators.

Wetlands are areas possessing unique qualities and functions resulting from their biological, chemical, and physical properties. Wetlands are flooded or saturated long enough during the year to develop anaerobic (oxygen-depleted) conditions in their soils. The chemistry of wetland soils in turn controls wetland biology, in particular the types of plants that live in wetlands. Some examples of wetlands are swamps or cienegas.

(Three factors or criteria must be present to have a wetland: (1) wetland hydrology, (2) wetland (hydric) soils, and (3) wetland (hydrophytic) plants. Field indicators for each of the three wetland criteria and wetland delineation methods are described in detail in the Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory 1987).

3.8.2.1 Regional Area

Riparian habitat along perennial streams accounts for only approximately 0.4 percent of the land area of Arizona (AGFD 1993). The SPRNCA consists of approximately 50,000 acres (78 sq. mi.) encompassing a 36 mile (58 km) perennial reach of the San Pedro River.

Sections of the San Pedro and Babocomari Rivers are perennial. The portion of the San Pedro River classified as a perennial stream is from the Hereford area to the vicinity of the Charleston Hills. These sections of perennial stream provide important and critical habitat for several special status fish and amphibian species. Two reaches of the Babocomari River are perennial for approximately 12 miles (19 km) and the segments are fed by baseflow (ADWR 1988).

The San Pedro River in the area of the SPRNCA flows through the Chihuahuan Desert shrub plant communities and the following description of the plant communities within the SPRNCA are from Stromberg et al. (1996). The lower floodplain of the river is dominated by Fremont cottonwood (*Populus fremontii*)/Gooddings willow (*Salix gooddingii*) while the terrace above the lower floodplain is dominated by velvet mesquite/giant sacaton (*Sporobolus wrightii*) bosques forest. Gooddings willow, a wetland obligate species, grows in the wettest areas along the river giving way to the facultative wetland species such as Fremont cottonwood, seep willow (*Baccharis salicifolia*), and, to a limited extent, salt cedar (*Tamarix chinensis*). In general, these plants grow in areas where depth to ground water in 9 feet (3 m) or less. However, willow and cottonwood seedlings require groundwater at 3 feet (1 m) or less. As the area becomes drier and the depth to groundwater increases, velvet mesquite and netleaf hackberry (*Celtis reticulata*) become the dominant woody species; these plants occur where depth to groundwater is 9 to 24 feet (3 to 8 m). The dominant herbaceous plant species in the wettest areas are sand spikerush (*Eleocharis montevidensis*), smooth scouring rush (*Equisetum laevigatum*), Torrey's rush (*Juncus torreyi*), baltic rush (*J. balticus*), hard-stemmed bulrush (*Scirpus acutus*), and southern cattail (*Typha domingensis*). These species occur in areas of permanent water or where depth to groundwater is shallow (less than 0.8 feet or 0.25 m). In dryer areas, naked-spike ragweed (*Ambrosia psilostachya*), spiney aster (*Aster spinosus*), and white-sweet clover (*Melilotus albus*) are common (depth to groundwater 3 to 9 feet or 1 to 3 m). Giant sacaton is a common species in the driest areas of the floodplain (depth to groundwater 9 to 24 feet or 3 to 8 m).

3.8.2.2 Fort Huachuca

Three types of streams found on Fort Huachuca and in the region of influence are ephemeral, intermittent, and perennial. Ephemeral streams are characterized as dry washes, arroyos, or gulches in the southwestern

U.S. (ENRD 1996a). These streams flow for only a brief period during and after winter or summer downpour rain events. Perennial streams flow all year. Intermittent streams flow seasonally, but are dry for at least part of the year.

Three riparian vegetation types have been identified on Fort Huachuca: (1) Sonoran Riparian Deciduous Woodland (Mesquite Bosque Series), (2) Interior Riparian Deciduous Forest (Cottonwood-Willow Series and Mixed Broadleaf Series), and (3) Madrean Montane Riparian Forest. Garden and Huachuca Canyons support most of the riparian habitat on post, which covers 674 acres (1.1 sq. mi.).

Wetlands are primarily associated with streams and ponds on the installation. No delineation of wetlands has been accomplished to determine if any of the wetlands present meet the criteria of jurisdictional wetlands. However, it is expected that Garden Canyon, McClure Canyon, and Huachuca Canyon have the attributes to meet the requirements and Fort Huachuca is managing these site accordingly. The delineation of a site as a jurisdictional wetland is defined in Section 404 of the Clean Water Act and would require that activity on the site receive federal approval.

Most non-jurisdictional wetland areas on the installation have been mapped as part of the USFWS wetland inventory (ENRD 1995). Most of the wetlands on the installation have formed perennial streams. Garden, Huachuca, and McClure Canyons all contain identifiable wetland sites. Some artificial wetlands have developed accidentally and are associated with restricted drainage from past road construction or plugged drainage culverts. Other artificial wetlands have developed around man-made ponds, and erosion control impoundments.

The dry washes on Fort Huachuca are typically narrow channels, with the fluvial portion composed mostly of a layer of sand and gravel several meters thick. The banks of these channels usually support grass such as big sacaton. The channels serve to carry runoff to larger drainage systems and also serve as the main interconnection of surface water to groundwater. The ephemeral water bodies (i.e., pools and puddles) that form during the rainy seasons create sources of drinking water for larger animals and breeding sites for amphibians (e.g., spadefoot toad) and various invertebrates (e.g., insects) that require aquatic habitat during part of their life cycle. Ephemeral streams are present on Fort Huachuca in the East, West, and South Ranges, as well as the cantonment area.

Perennial streams provide habitat for amphibians, aquatic plants and invertebrates, and fish. Although a few streams on Fort Huachuca sustain perennial or intermittent flows along some reaches, most drainages and surface depressions are dry except during periods of intense or prolonged rainfall. Fort Huachuca has approximately 4.5 miles (7.2 km) of perennial streams (ENRD 1996a). Garden Canyon in the South Range has about 3.5 miles (5.6 km) of perennial stream, McClure Canyon has about 0.25 miles (0.4 km), and the remaining 0.75 miles (1.2 km) are within Huachuca Canyon. No perennial streams are located within the cantonment area or the East Range. These streams are usually spring-fed and maintained by shallow groundwater.

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There are 39 identified springs on Fort Huachuca (ENRD 1996a). The springs are important habitats for the Huachuca springsnail which is only found in or within a few meters from the springs. There are 16 ponds on post that range in size from approximately one to five acres and are open for public use. The ponds provide a drinking water source for terrestrial wildlife species. Seven ponds are stocked with trout when conditions are favorable. These ponds are managed for recreational use. In the East Range, there are five additional ponds with 25.7 acres total surface area that are used to hold treated effluent.

3.8.3 Wildlife

The significant wildlife diversity found in the region of influence is directly related to the habitat diversity in this region. The isolation of the Huachuca Mountains from the other mountain ranges in the region of influence results in "mountain islands." In addition, proximity to Mexico results in some wildlife species here that are not known to occur elsewhere in the U.S., or are more commonly associated with the tropics. The result of this confluence of diverse habitats is that southeastern Arizona possesses one of the greatest diversities of bird species of any similarly sized region in North America (Taylor 1995a). More than 400 species occur here each year, and a total of almost 500 species has been recorded (Taylor 1995a). Three dozen of these species, including the elegant trogan and the white-eared hummingbird, are generally not found anywhere else in the U.S. According to the AGDF, wildlife populations in Cochise county are generally stable (Heffelfinger, personal communication 1996).

Another example of the diversity of the region is the 75 species of amphibians and reptiles that occur in the Huachuca Mountains and Upper San Pedro River (Taylor 1995b). In the early 1990s, a study was conducted in the Huachuca Mountains to gather baseline data concerning the distribution and abundance of amphibian and reptile species by vegetation type (Morrison et al. 1995). These populations will continue to be monitored in the future.

3.8.3.1 Regional Area

The SPNRCA contain 228 species, or more than half of the total terrestrial wildlife species found in the region (BLM 1989). The upland portion of the study area consists of 21 plant associations and is used by about 200 species of wildlife of which about 65 percent are birds, 20 percent are mammals, and 15 percent are reptiles and amphibians (BLM 1989). A list of these species is presented in Appendix 6 of the San Pedro River Riparian Management Plan and Environmental Impact Statement (BLM 1989).

Historically, 13 native species of fish were present in the Upper San Pedro River (Table 3.8-1). Of these, only two remain in the stream, the longfin dace and desert sucker. Fourteen species of non-native fish currently inhabit parts of the Upper and Lower San Pedro River or its tributaries (refer to BLM 1989 for a complete list of aquatic species).

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The Nature Conservancy's 300-acre Ramsey Canyon Preserve, located south of the installation, is an internationally renowned birding site, especially popular because of its numbers and varieties of hummingbirds. A total of 14 hummingbird species are found here as well as the rarely seen elegant trogans and eared trogans.

Table 3.8-1. Upper San Pedro River Native And Exotic Fish

Species of Native Fish	Species of Exotic Fish
loach minnow	common carp
flannel-mouth sucker	rainbow trout
roundtail chub	black bullhead
spikedace	green sunfish
longfin dace	mosquitofish
desert sucker	goldfish
Gila topminnow	fathead minnow
Sonora sucker	yellow bullhead
razorback sucker	channel catfish
Gila chub	bluegill
Colorado River squawfish	largemouth bass
speckled dace	brook trout
desert pupfish	threadfin shad
	red shiner

3.8.3.2 Fort Huachuca

The biotic diversity on Fort Huachuca mirrors similar habitats outside installation boundaries. More than 130 species of butterfly have been observed, collected, and positively identified in Garden and Sawmill Canyons at Fort Huachuca (Kral 1991). Among butterfly species known to have very limited ranges are: the Huachuca giant skipper, occurring in the Huachuca Mountains and having a dependent relationship with an agave species; and the orange-headed roadside skipper, found only in the Huachuca and Chiricahua Mountains (Williamson, personal communication 1996).

The bird species of Fort Huachuca have been treated in an informational checklist. This compilation was undertaken not only to serve birdwatching needs but also to provide scientific documentation of the species present on post. A similar document, "Location Checklist to Birds of the Huachuca Mountains and the Upper San Pedro River" (Taylor 1995b) provides more current information and notes on species of particular interest such as spotted owl, turkey, and various hummingbirds.

Fort Huachuca also boasts a very diverse population of mammals. Large mammals found on post include Coues white-tailed deer, desert mule deer, pronghorn antelope, collared peccary or javelina, mountain lion, and black bear. At least 14 species of bats occur on the installation, many of which are candidate species;

Pronghorns were introduced on the installation in 1949 and have primarily been maintained on the West Range. Population numbers have fluctuated widely, perhaps due to weapons firing or because of habitat loss due to Army construction projects (ENRD 1990). To offset these effects, the Army has transplanted pronghorn to other areas of the installation, mainly in the East and South Ranges. In addition, the Chihuahuan subspecies of pronghorn was introduced to the installation, beginning in 1987. Although this species formerly existed in southeast Arizona, it was extirpated in the 1800s and is now listed as a threatened species of special concern by the AGFD.

Mortality rates of the Chihuahuan pronghorns have been high, primarily due to coyotes. The installation's Game Management Branch has prepared a Pronghorn Antelope Management Plan, which addresses the issues of predator control and habitat improvements such as placement of water catchments and controlled burning of desert grasslands (ENRD 1990).

No native fish have been observed during brief electrofishing surveys conducted on Fort Huachuca in 1980 and the summer of 1995 (Stone 1995). The surveys were performed in streams in Garden Canyon.

In the past, several species of exotic fish are stocked in fishing ponds on Fort Huachuca. The species included rainbow trout, largemouth bass, bluegill and red ear sunfish, and catfish species. Approximately 18,000 rainbow trout are stocked for 'put and take' harvest each year, whereas numbers of the other species are more irregular (Stone 1996). Rainbow trout is the only species currently being stocked.

No data were available on benthic macroinvertebrates or amphibians at Fort Huachuca, except for several sensitive species such as the Huachuca springsnail and several amphibians, which are discussed in Appendix B: Threatened and Endangered Species.

3.8.3.3 Protected Species

The USFWS, which has regulatory responsibility for implementation and enforcement of the ESA of 1973, as amended, classifies unique or sensitive species as either endangered, threatened, proposed (threatened or endangered), or candidate. In the State of Arizona, rare or declining species are listed as Wildlife of Special Concern (WSCA). WSCA in Arizona are defined as species whose occurrence in Arizona is or may be in jeopardy, or with known or perceived threats or population declines. This state list is developed by the State and approved by the Arizona Game and Fish Commission. Information about those species identified by USFWS and relevant to the region of influence is contained in Appendix B: Threatened and Endangered Species.

Table 3.8-2 summarizes the federal and state status and potential for occurrence at Fort Huachuca and within the region of influence for species identified by USFWS. The occurrence codes in the table were developed by analyzing the range, distribution, abundance, and habitat parameters for each species through a review of recovery plans, listing packages, scientific literature, and consultation with endangered species biologists. A species was assigned a code of "1" if it is known to occur at Fort Huachuca. A code of "2" was assigned if potential habitat is present at Fort Huachuca, but one or more of the following criteria were true: surveys at Fort Huachuca have not detected the species (e.g., Chiricahua leopard frog); the range and/or distribution of the species is not likely to include Fort Huachuca (e.g., New Mexican ridge-nosed rattlesnake); or abundance of the species in Arizona is sufficiently low that occurrence at Fort Huachuca is highly unlikely (e.g., ocelot). If no suitable habitat exists at Fort Huachuca, the species was assigned a code of "3". A code of "4" was assigned if the species occurs in the SPRNCA or nearby stretch of the Babocomari (e.g., Canelo Hills Ladies' Tresses). A code of "5" was assigned if potential habitat for the species is present (or may have historically occurred) in the SPRNCA or nearby stretch of the Babocomari environment but species is not known to occur (e.g., Spikedace). If no suitable habitat exists in the SPRNCA or nearby stretch of the Babocomari environment a code of "6" was given. Figure 3.8-2 shows the generalized areas where known populations of federally listed species occur on the installation.

A recent search of the AGFD's Heritage Data Management System (AGFD 1998), indicated that five federally endangered or threatened animals and plants have been documented on Fort Huachuca. The American peregrine falcon, the lesser long-nosed bat, the Sonoran tiger salamander, and the Huachuca water umbel are listed as endangered and occur on Fort Huachuca. The Mexican spotted owl, listed as threatened, is known to nest on the installation where much suitable habitat exists. There is one aquatic federal candidate species that occurs on Fort Huachuca-the Huachuca springsnail. Two federal candidate plants are also known to occur on the installation: Blumer's dock (proposed threatened) and Lemmon fleabane. Lands adjacent to the East Range of the installation in the SPRNCA have been designated critical habitat for the Southwestern willow flycatcher.

The American peregrine falcon has a range that stretches from central Alaska south into Mexico. This subspecies had a population of 55 pairs in 1975 when the recovery plan was written. By 1984 there were 180 pairs of American peregrine falcon. In April of 1996 a pair was verified in an upper canyon area of Fort Huachuca. These are the first confirmed resident American peregrine falcons on the installation in over 30 years. A detailed discussion of this species is in Appendix B.

The lesser long-nosed bat occurs on Fort Huachuca and at other locations in the Huachuca Mountains and San Pedro River Basin from late April through October. This bat is a nocturnal feeder that migrates from Mexico to this area. Stands of agave located on the West and South Ranges of the installation provide forage for the bats, who roost in caves on the installation. A detailed discussion of this species is in Appendix B.

The Sonora tiger salamander has been confirmed at one site on Fort Huachuca in a man-made tank in a high canyon. Two other populations exist in the Huachuca Mountains in Scotia and Copper Canyons. Though no critical habitat designations have been made for this species, stock ponds and springs on the West and South Range may represent potential habitat for the salamander. A detailed discussion of this species is in Appendix B.

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Table 3.8-2. Federal And State Protection Status And Potential Occurrence For Species Of Concern, Fort Huachuca And The San Pedro River NCA[1].

Species	Federal Status	State Status	Occurrence Ft Huachuca	SPRNCA
PLANTS				
Blumer's dock (*Rumex orthoneurus*)	proposed threatened	HS	1	6
Canelo Hills Ladies' tresses (*Spiranthes delitescens*)	endangered	HS	3	5
Cochise pincushion cactus (*Coryphantha robbinsorum*)	threatened	none	3	6
Huachuca water umbel (*Lilaeopsis schaffneriana*)	endangered	HS	1	4
Lemmon fleabane (*Erigeron lemmonii*)	candidate	HS	1	6
INVERTEBRATES				
Huachuca springsnail (*Pyrgulopsis thompsoni*)	candidate	none	1	5
BIRDS				
Mexican spotted owl (*Strix occidentalis lucida*)	threatened	WSCA	1	6
Mountain Plover (*Charadrius montanus*)	candidate	None	3	6
Northern aplomado falcon (*Falco femoralis septentrionalis*)	endangered	WSCA	2	5
Peregrine falcon (*Falco peregrinus anatum*)	endangered	WSCA	1	5
Southwestern willow flycatcher (*Empidonax traillii extimus*)	endangered	WSCA	3	4
Whooping crane (*Grus americana*)	endangered	WSCA	2	5
MAMMALS				
Jaguar (*Panthera onca*)	endangered	WSCA	2	5
Jaguarundi (*Felis yagouaroundi tolteca*)	endangered	none	3	5
Lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*)	endangered	WSCA	1	6
Mexican gray wolf (*Canis lupus baileyi*)	endangered	WSCA	2	5
Ocelot (*Felis pardalis*)	endangered	WSCA	3	5
AMPHIBIANS AND REPTILES				
Chiricahua leopard frog (*Rana chiricahuensi*)	*candidate*	WSCA	2	5
New Mexican ridge-nosed rattlesnake (*Crotalus willardi obscurus*)	threatened	WSCA	3	6
Sonora tiger salamander *Ambystoma tigrinum stebbinsi)*	endangered	WSCA	1	6
FISH				
Beautiful shiner (*Cyprinella formosa*)	threatened	none	3	6
Gila chub (*Gila intermedia*)	candidate	WSCA	2	5
Yaqui chub (*Gila purpurea*)	endangered	WSCA	3	6
Yaqui catfish (*Ictalurus pricei*)	threatened	WSCA	3	6
Yaqui topminnow (*Poeciliopsis occidentalis sonoriensis*)	endangered	WSCA	2	5

1 Species list for Cochise County provided by USFWS (1997d)

DEFINITIONS

Federal status as defined by the USFWS under the Endangered Species Act (ESA):

- endangered: species which are in imminent jeopardy of extinction
- threatened: species which are in imminent jeopardy of becoming endangered
- candidate: species for which there is sufficient information to support a proposal for listing under the ESA

For State status Wildlife of Special Concern in Arizona (WSCA) as defined by AGFD in Public Review Draft 1996.

For plant species "highly safeguarded" (HS) as defined by Arizona Native Plant Law (1993)

Occurrence status:

- 1: species occurs on Fort Huachuca
- 2: potential habitat present but species is not known to occur on Fort Huachuca
- 3: no potential habitat present and species is not known to occur on Fort Huachuca
- 4: species occurs in SPRNCA
- 5: potential habitat present, species may have occurred historically, but species is not known to occur in SPRNCA
- 6: no potential habitat present and species is not known to occur in SPRNCA

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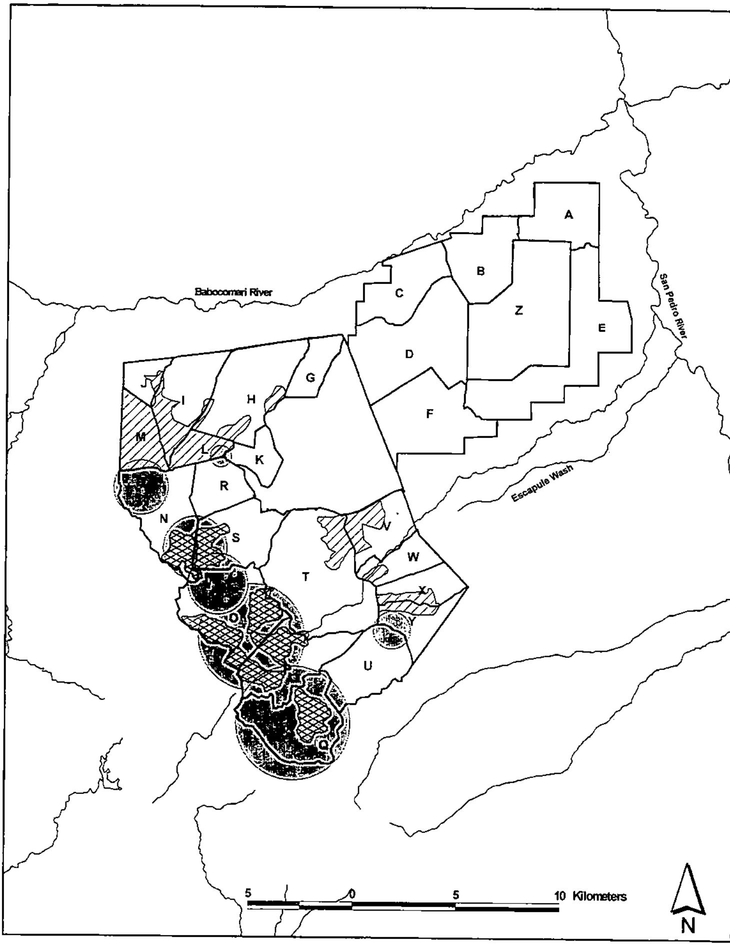

FIGURE 3.8-2

Species and Habitats of Concern on Fort Huachuca

NOTE: Species locations on this map are generalized for natural resource protection

Agave Stands
Mexican Spotted Owl Protected Activity Areas
Listed Species Location

The Huachuca water umbel is a cienega dependent plant that occurs in Santa Cruz and Cochise Counties and in adjacent Sonora, Mexico. The Huachuca water umbel is found at six locations on the installation in Garden and Sawmill Canyons (Stone, personal communication 1997). The primary threat to this species is alteration of ground and surface water flows which may degrade or destroy wetland habitats (USFWS 1995). A detailed discussion of this species is in Appendix B.

The Mexican Spotted Owl is a medium size bird that ranges from central Colorado and Utah, Arizona, New Mexico, and western Texas, south to the Mexican states of Michoacan and Puebla (FR June 6, 1995, Vol. 60, No. 108). Mexican spotted owls have been observed in Huachuca, McClure, Rock Spring, Split Rock, Sawmill and Tinker Canyons. A detailed discussion of this species is in Appendix B.

The southwestern willow flycatcher, an endangered species, is a neotropical migrant that has been extirpated across much of its breeding range throughout southwestern United States. In Arizona, this bird is a Wildlife of Special Concern (WSCA). The SPRNCA adjacent to the Fort contains critical habitat for the species although no suitable breeding habitat for this subspecies exists on Fort Huachuca (personal communication Warren 1996). Surveys along the San Pedro River in the SPRNCA in 1997 revealed that areas of acceptable southwestern willow flycatcher breeding habitat were interspersed with areas of marginal habitat. These surveys found the first documented occurrence of this species nesting in the SPRNCA since it was created in 1988 (Wetston 1997). The nesting pair in the SPRNCA established its first nest in a Gooddings willow; this nest was destroyed by unknown causes and a second nest was built in a seepwillow. However, it appears this nest was abandoned in July 1997 with one dead cowbird young in the nest (Krueper, personal communication 1997). In 1996, a breeding pair of southwestern willow flycatchers was located along the San Pedro River near St. David, approximately 30 miles (48 km) north of Fort Huachuca and about five miles north of the SPRNCA (Corman, personal communication 1997). In 1993, flycatchers were found at three sites along the lower San Pedro River over 50 miles (80 km) from Fort Huachuca (Muiznieks et al. 1994). At least 13 territories were found, representing one of the largest known populations. No birds had been detected during previous surveys conducted along the San Pedro River in 1986 (Muiznieks et al. 1994). A detailed discussion of this species is provided in Appendix B.

3.8.4 Biological Resource Management

A variety of biological resource management techniques are practiced at Fort Huachuca including prescribed burning and reseeding with native plant species to improve wildlife habitat, access limitation for erosion control, construction of wildlife watering facilities, and harvest management. The INRMP aims to integrate military training requirements with land and resource management and environmental programs, in order to better manage and conserve resources for sustainable use. Several wildlife management plans developed for Fort Huachuca are listed below (Nakata 1997a).

FMC003418

- Whitetail Deer Management Plan
- Pronghorn (Antelope) Management Plan
- Javelina Management Plan
- Fish Management Plan
- Desert Mule Deer Management Plan
- Gould Turkey Reintroduction Plan
- Problem Bear Plan
- Forest Management Plan

3.8.4.1 Forest Management

Although approximately 23,000 acres (36 sq. mi.) on Fort Huachuca are considered as forest or woodland, there is little or no potential for a commercial forestry operation (ENRD 1995). However, salvaged timber and firewood have been sold by the installation to the public in the past. Fort Huachuca's Forest Management Plan provides information and guidance for the multiple use of forest lands and the conservation of forest resources. The plan addresses the issues of fire management, use and sale of forest products, recreation, wildlife, and insects and disease (ENRD 1995). Reports and records of the forest management program are maintained on an annual basis and filed at the Fort's Forestry Office.

3.8.4.2 Grazing Management

The Fort Huachuca Grazing Management Plan is a component of the INRMP. Currently, no grazing occurs on the installation with the exception of the Buffalo Corral. A Grazing Management Plan for Buffalo Corral Rental Horses at Fort Huachuca was completed in 1993 (USDA 1993).

3.8.4.3 Fire Management

The Fort Huachuca Fire Management Plan (ENRD 1995) provides guidance to Army personnel, as well as to the USFS, on the use and management of wildlife habitat while protecting human safety and military assets. Environmental effects and mitigation measures for controlled burns have been discussed in previous environmental documents (USAG 1991).

3.8.4.4 Game Management

Fort Huachuca has a number of game species: black bear, mountain lion, javelina, pronghorn, white-tailed deer, desert mule deer, turkey and various waterfowl. The Army has prepared management plans and harvest reports for whitetail deer, mule deer, and antelope (ENRD 1990). These provide information on hunt numbers, antler development, census results, management strategies, and habitat improvements, among other topics.

Hunting and harvest are regulated with the aims of sustaining healthy, productive populations and providing multiple uses compatible with military training activities. Hunting is allowed on post land outside the cantonment and other developed areas for eligible persons with appropriate state and post licenses who meet requirements for hunter education and abide by regulations (ENRD 1994a).

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3.8.4.5 USFWS Consultation

The Army and Fort Huachuca tenants regularly consult, and will continue to consult, with the USFWS regarding sensitive species issues at Fort Huachuca and other areas potentially impacted by activities. Appendix H includes scoping comments from the USFWS related to this EIS.

3.8.4.6 Ramsey Canyon Leopard Frog Management Agreement

A Ramsey Canyon Leopard Frog Management Agreement was signed in 1997 by The Nature Conservancy, Fort Huachuca, USFWS, and a local private landowner. This agreement provides for monitoring and management of the species and was implemented to protect this federal candidate species and therefore eliminated the need to list the species.

3.9 SAFETY

This section addresses safety concerns associated with the operation of Fort Huachuca. It focuses on wildfires, explosives, public safety, and related matters. Safety information was collected from Fort Huachuca files and discussions with Range Control and other responsible organizations. Traffic safety is discussed in Section 3.12.

3.9.1 Fire and Wildfires

Both in the cantonment and on the training ranges fire is a major safety concern. On the ranges, wildfires are of special concern since all normal operations must cease during a wildfire emergency. In addition, wildfires result in degraded bivouac and training areas, increased soil erosion, and loss of wildlife habitat. Risk from wildfire is the greatest during the dry summer months.

The Fort Huachuca Fire Department is responsible for fire fighting services within the Military Reservation. Fort Huachuca's fire fighting personnel consists of 17 people per day. Fire fighting equipment includes three 1,200-gallon tankers and two 400-gallon trucks, all with pump and roll capabilities (Chambers Group 1994). Mutual aid agreements are in place with the USFS, Sierra Vista, Huachuca City, and Palominas Fire Departments in the event of major fires. In addition to the mutual aid agreements, Fort Huachuca has a Memorandum of Understanding (MOU) with the USFS that allows Fort Huachuca access to the National Wildfire Coordinating Group and the provision by the USFS of one Type 7 engine, one slurry bomber, and two USFS personnel to be stationed at the installation from April 1 to August 1. Fort Huachuca pays the USFS $20,000 a year for this additional protection (Chambers Group 1994). The range manager at Fort Huachuca has the authority to restrict activities on the range at any time. No live-fire activities are allowed on the range during periods of extreme fire hazard (Chambers Group 1994).

3.9.2 Unexploded Ordnance (UXO)

UXO potentially exists on the West, South, and East ranges. The number of firings is carefully monitored and any UXO is immediately searched for and removed (Chambers Group 1994).

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UXO may occur on the East Range target area, which is sometimes used for live fire of explosive mortar rounds. Any UXO is left in place and the area is placed off limits to personnel without express approval of Range Control and the Garrison Commander (Beil 1996).

3.9.3 Public Safety

Road closure, warning signs, and red range flags are used by Range Control to help restrict access to ranges when they are in use.

3.10 ENERGY

Energy used at Fort Huachuca includes electricity, stationary fuels, and vehicle and aircraft fuels. These services are the focus of this section.

Energy and fuel consumption figures were compiled from data provided by the Fort Huachuca Energy Office, motor pools, and LAAF. These data are assessed in order to provide a basis for analyzing potential energy impacts from the proposed action.

3.10.1 Electricity

The Tucson Electric Power Company supplies electrical power to Fort Huachuca. The capacity of the primary transmission line is 138,000 kilovolt amperes (kVA) and 46,000 kVA for the installation substation. It is transmitted to the facility via high voltage overhead transmission lines and distributed within the facility via lower voltage overhead and underground transmission lines. The voltage is stepped down via transformers to standard working voltages at each point of use. Fort Huachuca used 103,723,000 kilowatt hours (kWh) in 1993; 106,478,000 in 1994; 106,645,800 in 1995, 107,980,400 in 1996, and 105,712,000 in 1997 (refer to Appendix G for usage by month). This represents a 4.1 percent increase from 1993 to 1996 but a 2.1 percent decrease from 1996 to 1997.

3.10.2 Stationary Fuels

Stationary fuels are used primarily for space heating and in absorption chillers to provide cooling. Heating and cooling fuels used at Fort Huachuca are natural gas and propane.

Southwest Gas Company furnishes natural gas to Fort Huachuca through a high pressure underground pipe line which is then distributed within the installation via a network of buried transmission lines. This line is currently operating at 50 percent capacity. Natural gas consumption at Fort Huachuca was an estimated 447,106 Million British Thermal Units (MBTU) in FY97. Natural gas consumption for the past few years have been well below peak historical consumption levels. The highest natural gas consumption in the past five years (1992) was 632,436 MBTUs, which was 84 percent of the peak year consumption over the past 20 years (1975).

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Propane is produced off-site and transported to Fort Huachuca via truck. The highest propane consumption for the past five years (1992) was 3,962 MBTU, which was 64 percent of the peak year consumption (1986). Given these trends, the delivery and distribution capacities for these energy products are not likely to be reached or exceeded within five years.

3.10.3 Vehicle and Aircraft Fuels

Because of the mix of activities, consumption of vehicle and aircraft fuels at Fort Huachuca is a smaller fraction of total energy consumption than at most other military installations. Vehicle and aircraft fuels (mobility fuels) are used in military training programs, as well as in facility operation. Mobility fuels used at Fort Huachuca are unleaded gasoline (MOGAS), diesel fuel, aviation gasoline (AVGAS), and JP8 jet fuel. The FY94 consumption was 227,454 gallons of unleaded gasoline, 344,122 gallons of diesel fuel, 2,161 gallons of aviation gasoline, and 1,732,547 gallons of jet fuel. These totals were all smaller than in recent previous years. The reduction in diesel fuel consumption reflects differences in the mix of training activities from year to year. The reduction in the usage of aviation fuels reflects the reduction in take-off and landing operations that resulted from reduced operating hours at LAAF and reconstruction of the main runway.

The total quantity of mobility fuels used at Fort Huachuca has a minimal effect on the fuel supply and distribution system in southeastern Arizona. The total annual consumption of petroleum fuels represents less than two days of production of a typical refinery. This quantity can be delivered using standard tank trucks at the rate of slightly more than one truck per work day.

3.10.4 Alternative Energy Sources

Modest but growing amounts of solar energy are used at Fort Huachuca. Solar energy neither depletes natural resources nor produces air pollution. The Army goal for renewable energy use is 10 percent of stationary consumption by the year 2005. Several domestic hot water systems have been installed at Fort Huachuca. Among the largest of these is a 900 sq.ft collector at Barnes Field House. The Barnes pool is also heated with a 2,000 sq.ft. collector. Fort Huachuca makes use of photovoltaic energy for a few specialized applications such as some marquee signs and parking lot and street lights. A 7.5-kW solar-powered Stirling engine generator is currently in planning. In addition, preliminary studies are underway of wind energy potential in the Garden Canyon area.

3.10.5 Consumption and Conservation Patterns

The TRADOC energy reduction goal for Fort Huachuca is a 24.5 percent reduction of the FY90 stationary energy consumption by the year 2000. Since the energy reduction program began in 1992, Fort Huachuca has gone from being 8.1 percent above the annual goal to 5.93 percent below its goal in FY95, which equated to a $617,874 savings. In FY95, Fort Huachuca had an energy density of 95.48 MBTU per thousand sq.ft., a 16 percent energy density decrease from the base year of FY85. Fort Huachuca received DOD and

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DOE Energy and Water Management Awards for FY95 and FY96 for the strong performance of its Facilities Energy Resources Management Program (ERMP). The Fort Huachuca ERMP, which incorporates energy efficient building components into new facilities, retrofits older buildings and facilities with energy efficient equipment, and establishes an effective public awareness program, is currently one of the top-rated programs within the DoD.

To provide a fair comparison of energy consumption patterns from year to year and from installation to installation, stationary consumption (electricity and heating/cooling fuels) usually is expressed in terms of consumption per thousand sq.ft. of building floor space. Fort Huachuca's Year 2005 goal is a 30 percent reduction in energy use per sq.ft. compared with the base year of 1985, with proportional goals during intermediate years. Heating, cooling, ventilation, and water pumping tend to vary considerably from year-to-year because of variation in weather patterns. For this reason, heating and cooling fuel consumption comparisons take into account the number of degree-days in the year. This is a standard method to consider the severity of the weather when analyzing energy consumption.

Energy conservation efforts at Fort Huachuca have resulted in steady declines in energy consumption over the last five years. The decreasing trend in installation population and water consumption is continuing, and the resulting energy savings are expected to continue as well. Approximately $90,000 worth of electricity used for pumping and water treatment was saved in 1995 due to water conservation efforts. Table 3.10-1 illustrates the downward trend in energy consumption per sq.ft. on the installation.

3.11 WASTE MANAGEMENT

A variety of wastes, including municipal solid waste, regulated waste, and hazardous waste are produced at Fort Huachuca. This section describes the above listed wastes and the regulations and practices which apply to them.

3.11.1 Hazardous/Toxic Materials and Waste Management

Fort Huachuca is aggressively implementing several environmental plans and programs for hazardous waste management and monitoring including (Nakata 1997b):

- AR 420-47 Solid and Hazardous Waste Management
- Hazardous Waste Management Plan
- Hazardous Waste Analysis Plan
- Hazardous Waste Training Plan
- Installation Spill Contingency Plan (ISCP)
- Spill Prevention, Control and Countermeasures Plan (SPCCP)
- Pollution Prevention Plan (Hazardous Waste Minimization)

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Table 3.10-1. Historical Energy Consumption

FY	Building Square Footage (KSF)	Effective Population	Energy Density MBTU/KSF
86	7,877	12,484	101.18
87	7,878	14,286	111.49
88	7,816	11,989	106.67
89	7,817	13,149	104.23
90	7,868	13,235	110.84
91	8,065	10,051	113.44
92	8,129	9,142	108.41
93	8,947	9,157	95.19
94	9,211	10,470	94.00
95	8,658	8,699	95.48

3.11.1.1 Hazardous Materials

Hazardous material storage follows the National Fire Prevention Association standard codes, and is subject to inspection by both the Installation Safety Office and the Fire Department.

In February 1996, the installation received a TRADOC Bold Grant to create and operate a Hazardous Material Center, which will allow for turn-in and withdrawal of usable hazardous materials on the installation. This center was designed to facilitate a reduction in the purchase and disposal costs associated with hazardous materials and wastes. The center opened in the fourth quarter of Fiscal year 1996.

The Fort Huachuca *Installation Spill Contingency Plan* (ISCP), dated 20 December 1996, describes the procedures to be implemented in the event of a spill of hazardous materials or petroleum, oils and/or lubricants (POL), both on and off post. A copy of this plan is available for review at the office of the DIS Environmental and Natural Resources Division. In the event of a hazardous material release, the Directorate of Public Safety has first responder responsibilities on the installation, with the DIS maintenance contractor responsible for cleanup once imminent danger to life and health has passed. Cochise County and the City of Sierra Vista provide backup for response to accidental spills of hazardous substances or POL on Fort Huachuca.

3.11.1.2 Hazardous Wastes

Hazardous waste management on Fort Huachuca is regulated by both the EPA and the ADEQ under the provisions of the Federal Resource Conservation and Recovery Act (RCRA) of 1976 and the Arizona *Hazardous Waste Management Act. Fort Huachuca is a large quantity generator, but does not maintain a* Part B permit to operate a treatment, storage, and disposal facility (TSDF) under RCRA. The installation operates one 90-day accumulation point and approximately 35 satellite accumulation points.

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Transportation to an approved TSDF is through contracts established by the Defense Reuse and Marketing Organization (DRMO) of the Defense Logistics Agency. The DRMO ensures that transporters are qualified, maintain required permits and licenses, and manifest the packaged waste off the installation to a permitted TSDF.

In the case of a hazardous waste release, the Directorate of Public Safety has first responder responsibilities on the installation, with the DIS maintenance contractor responsible for cleanup once imminent danger to life and health has passed. Under agreement with Cochise County and the City of Sierra Vista, backup for response to accidental spills of hazardous substances or POL on Fort Huachuca is available.

The Fort Huachuca *Installation Hazardous Waste Management Plan* (HWMP), dated January 1997, was designed to provide the necessary procedures to achieve compliance with the foregoing regulations regarding the accumulation, storage, transportation, and disposal of hazardous wastes generated by various organizations on the Fort. A copy of this plan is available for review at the office of the DIS ENRD.

3.11.1.3 POL Wastes

In Arizona, used POL products are regulated, and restrictions on disposal methods exist. Used POL products are tested to ensure that they do not contain RCRA levels of contamination. Products that are not contaminated are sold to a recycler through the DRMO.

3.11.2 Solid Waste Disposal and Landfills

There are no active landfills on Fort Huachuca. Historical landfills exist and are being considered for EPA closure under recent regulations. Municipal solid wastes (MSW) from Fort Huachuca are currently collected and disposed of under contract at the Huachuca City landfill by the Waste Management Corporation. The installation generates about 6,600 tons of refuse annually. Until 1997 the Huachuca City facility processed all refuse from Fort Huachuca through a reclamation process which removed recyclables from the refuse prior to placing it in the landfill. A recycling program for paper, aluminum cans, glass, and various types of plastics on the installation produced approximately 2,250 tons in 1994. This blue-bin program is managed by the Sierra Huachuca Association of Retarded Citizens (SHARC) and provides funding for some of their activities.

Construction and demolition (C&D) waste volumes vary depending on the amount of construction and demolition especially of old WWII structures occurring on the installation. These wastes are disposed by private haulers. Asbestos waste is currently accepted in the Elfrieda landfill, a county landfill.

3.11.3 Munitions

Fort Huachuca transports, stores, and uses munitions. Munitions may be classified as hazardous materials (ignitable, corrosive, reactive, or toxic) under provisions of the RCRA, and its relevant State equivalent (ARS 49-921-973), depending upon what they contain and how they are used. However, unless expired, improperly stored, treated, or disposed, military munitions generally do not meet the RCRA definition of hazardous waste. Fort Huachuca does not maintain stockpiles of non-conventional munitions (i.e. chemical, nuclear, etc.).

The Army has generated rules, regulations, and guidance manuals detailing procedures and practices for handling, storing, and disposing of munitions. All on-post activities comply with existing Army guidance documents, and federal and state regulations (including RCRA and ARS Title 49). Army guidance documents relevant to the handling, storage, and disposal of munitions include:

- *U.S. Army, 415S.19-R-l; Hazardous Commodities Storage*
- DEQPM 80-5, U.S. Army Hazardous Materials Disposal Policy
- DEQPM 80-8, RCRA

3.11.4 Fuels, Coolants, and Lubricants

Military vehicles operating on Fort Huachuca use hydrocarbon fuels, coolants, and lubricants. Bulk storage units have been located on-post since the early 1900s. Existing storage units include both above and below ground facilities.

On-post bulk storage units are required for both diesel and gasoline fuels. The large capacity storage units are located above ground, and have associated above and below ground pipelines and distribution systems. Smaller capacity tanks are generally located below ground and have underground distribution systems.

Lubricants and coolants are generally stored and distributed in steel drums. Some lubricants are stored in bulk, but are transferred to smaller units (e.g., 55-gallon steel drums) for distribution.

Fuel, coolants, and lubricants are generally considered product, not regulated as hazardous waste, however, these materials become regulated under RCRA (40 CFR Part 280) and its relevant state equivalent (ARS 49-1001 through 1073) if spilled, leaked, or improperly disposed. Leaks and spillage from non-fixed facilities, including vehicles and transportation units, fall under a different set of regulatory criteria, and are specifically covered in the Fort Huachuca Emergency Response and Spill Prevention Plan.

Fort Huachuca is a generator of spent motor oils and coolants. These waste materials may be classified as hazardous under RCRA if contaminated with trace metals and solvents. After initial collection in small volume buckets and drums (satellite collection and storage), waste-oils and coolants are transferred to 55-gallon drums or underground tanks for eventual treatment and disposal or recycling. Fuels, coolants, and lubricants are disposed of according to command, federal, and state regulations.

3.11.5 Solvents and Degreasing Agents

Vehicles, machines, and weapons operating on Fort Huachuca require periodic maintenance and retooling. Such maintenance operations may require use of solvents and degreasing agents. Many hydrocarbon-based solvents and degreasing agents are listed as hazardous wastes regulated under RCRA 940 CFR 261.4).

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3.11.6 Toxic Substances Control Act Regulated Materials (Asbestos and Polychlorinated Biphenyls)

As a general practice, the use of polychlorinated biphenyls (PCBs) in ballasts and capacitors was discontinued after 1974. Most electronics employed on the M-1 battle tank and support equipment were manufactured well after PCBs were replaced by (non-hazardous) materials. The presence of PCBs in tank electronics is not considered likely.

Asbestos insulation was found to be present in the old buildings of the Arizona National Guard WETS (Excel Tech 1990). To date, no asbestos has been removed, but removal would take place prior to any demolition. Asbestos is disposed of according to army, federal, and state regulations.

3.11.7 Batteries

Several battery types are used on military equipment including standard lead-acid automotive batteries, lithium batteries, lithium/magnesium batteries, mercury-containing batteries, and silver batteries. Batteries on post are disposed of according to command, federal, and state regulations. When properly used and disposed, batteries are not regulated under RCRA; however, spent batteries could be classified as hazardous waste in the event of breakage, leakage, or improper disposal.

3.11.8 Pesticides, Herbicides, and Rodenticides

Pesticides, herbicides, and rodenticide are stored and used on-post in accordance with prescribed regulations. There is a pesticide plan in use at the installation. This plan also includes pesticide use in on-post housing areas and at the golf course.

3.11.9 HAZMART

Fort Huachuca is the first installation to implement HAZMART. The HAZMART is the Army's first fully centralized facility for handling hazardous materials. The goal of the facility is to foster reduction, reuse and replacement of hazardous materials, and to reduce the generation of hazardous waste. The facility allows expedited sharing and acquisition of hazardous materials required for mission related work on the installation. The "cradle to grave" system at the HAZMART allows for ease in tracking the materials from the time they are brought on to the installation until they are either used up, returned for reuse or disposed of as hazardous waste. The potential of the HAZMART is a 50 percent reduction in the generation of hazardous wastes and a savings of over half a million dollars, possibly up to 1.5 million.

Common hazardous materials which may be found at the HAZMART include bleach, solvents, paints, and adhesives. No pesticides, explosives or medical products are stored at the HAZMART site. Fort Huachuca residents may also bring their household hazardous materials, such as varnish or cleaning products to the HAZMART for reissue. This is especially important when families move, because these materials often cannot be transported in their household goods. The HAZMART will allow the products to be used for their intended purpose and not be disposed of through legal or illegal methods.

3.12 TRANSPORTATION

This section focuses on the existing traffic patterns in the study area. This baseline information will be used as a point of comparison when evaluating traffic impacts that may be caused by the proposed action and alternatives discussed in this EIS.

The last traffic study conducted at Fort Huachuca was in 1989. The study was conducted by the Systems Engineering Division of the Military Traffic Management Command Transportation Engineering Agency (MTMCTEA), Newport News, Virginia. Onsite data was collected between May 8th to the 19th in 1989. Results and recommendations from the study are published in Military Traffic Management Command (MTMC) Report SE 89-6a-33, Traffic Engineering Study, Fort Huachuca, Arizona, March 1990. Information from this report was used to establish baseline traffic conditions for Fort Huachuca.

3.12.1 Existing Transportation System

The only major roadway that provides access to the City of Sierra Vista and Fort Huachuca is State Route 90. State Route 90 provides access to Interstate 10 and the nation's interstate system. Interstate 10 is approximately 25 miles (40 km) north of Fort Huachuca.

Access to Fort Huachuca is provided through three gates; Main Gate, East Gate, and West Gate. The West Gate serves a low volume of traffic. A dirt road travels from the West Gate to the Mexican border. The East and Main Gates are located on State Route 90 and handle the remainder of base traffic.

The roadway network inside Fort Huachuca consists of primary and secondary collector streets, and local or residential streets. Roadways that carry large volumes of traffic (6,000 to 10,000 vehicles per day) are classified as primary collector streets. These roadways have cross-sections of up to 4 lanes with a median, shoulders and sidewalks. Primary collector streets on post include Hatfield Street, Irwin Street, Allison Road, Whitside Road, Brainard Road, Winrow Road between the Main Gate and Allison Road, and Smith Avenue between Hatfield Street and Whitside Road.

Roadways that connect residential or commercial areas to primary collector streets are classified as secondary collector streets. Secondary collector streets carry less traffic (between 2,000 to 8,000 vehicles per day) and are built to lesser design standards than primary collectors. Secondary collector streets have cross-sections of up to four lanes with a median and sidewalks. Roadways on post classified as secondary collectors include Cushing Street, Arizona Street, Squire Avenue, Smith Avenue east of Hatfield Street, Hines Road, Windrow Road west of Allison Street, and Carter Street south of Hatfield Street. All other roads on post are classified as residential or local streets.

Public transportation is provided by the Sierra Vista Public Transit System, which is operated by Catholic Services of Cochise County. Transportation is available to the general public with special attention for the physically challenged, developmentally impaired, and senior citizens. Residents of the region have access to

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the Sierra Vista Municipal Airport, which provides commuters airline services and ground transportation. Taxi rental is also available.

From 1989 data, 86 percent of the motorists entering Fort Huachuca drove alone. Fort Huachuca has a vehicle occupancy ratio of 1.16 passengers per vehicle. This is below the DoD average of 1.3. However, some people did arrive at Fort Huachuca by bus. Some of the bus trips originated in Tucson, showing that people who traveled a long way will carpool. It is unlikely that the percentage of people carpooling has significantly changed since 1989.

Peak traffic within the cantonment area of Fort Huachuca occurs during the commute hours of 0600 to 0800 (6 to 8 AM) and 1530 to 1730 (3:30 to 5:30 PM). The traffic volumes from the 1990 report are generated from the 1989 base population. The 1989 base noontime population was 17,133 persons. The 1995 noontime population on base is 15,842 persons. The 1995 noontime population is 7 percent lower than the 1989 noontime population, therefore, it is expected that 1995 traffic volumes would be 7 percent lower than 1989 volumes. No major deficiencies in transportation infrastructure or service were identified in the AAA audit of BRAC 95 (ENRD 1997c) traffic study, thus with less traffic volumes, no major deficiencies in transportation infrastructure currently exist at Fort Huachuca.

There are no railways operating on Fort Huachuca. The nearest railhead is at Benson, Arizona, approximately 25 miles north of Fort Huachuca. Another railhead used by Fort Huachuca is located at Davis-Monthan Air Force Base in Tucson, Arizona, 70 miles to the north.

Three runway areas exist on Fort Huachuca. The largest of these is LAAF, which comprises approximately 2,500 acres (3.9 sq. mi.) on the northern edge of the cantonment area (see Section 3.1.1.2).

The second runway area, Rugge-Hamilton field on the West Range, is used for UAVs. The landing strip, 2,250 feet (675 m) long, is not paved but has been improved through grading and compaction. The third runway area, Hubbard airstrip, consists of a graded, compacted, unpaved landing strip used primarily for C-130 practice landings by the Missouri National Guard. The runway is 4,000 feet (1200 m) long with a 300 foot (90 m) overrun at each end.

3.12.2 Mobilization

Fort Huachuca has a mobilization and deployment mission as part of its overall mission baseline. This mission can be exercised during times of war or other national emergency.

Fort Huachuca's roles and responsibilities during a declared state of national emergency or war are outlined in the Mobilization and Deployment Plan (USAIC & FH 1996) which replaces a 1991 plan.

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3.12.3 Discussion

Fort Huachuca is under the operational control of U.S. Fifth Army for mobilization and deployment planning and execution of FORSCOM missions (USAIC & FH 1996). Fort Huachuca has approximately 39 reserve component units, 2500 military retirees, and 30 individual mobilization augmentees assigned for mobilization and deployment contingencies. While this number fluctuates as changes in force structure occur, a reasonable estimate is that the installation's population could increase by 3,200 people during a full mobilization. During operation Desert Storm in 1991, the installation population temporarily increased by approximately 3,000 people.

During mobilization, Fort Huachuca would attempt to accommodate as many new people as possible in existing buildings reducing the need for new construction and field camps. Riley barracks, the Arizona National Guard WETS, and, as needed, available WWII-vintage, temporary wooden structures would be used to handle personnel peaks. During full mobilization some tent camps may be needed to house troops. These camps would be located on the ranges and in areas previously surveyed for, and absent, archeological and cultural resources. Additional efforts would be made to minimize other environmental impacts and comply with environmental regulations.

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4.0 ENVIRONMENTAL CONSEQUENCES

This section provides a comparison of the environmental consequences associated with the three alternatives analyzed in this DEIS (no action, proposed action, alternative action). The proposed action is to approve the three RPMP component updates (LRC, SRC and CIS) and authorize the steps leading to project implementation. This includes the approval of currently recommended programmatic changes in the installation's facilities and infrastructure that may be anticipated within the near future. The proposed action is a planning and authorization function; the actual implementation of these three RPMP component plan updates and the construction projects identified for future construction therein are subject to additional NEPA evaluation as appropriate. A summary evaluation of the key issues and probable impacts of implementing these individual construction projects is contained in Appendix F of this DEIS.

Planning and authorization functions associated with the proposed action would result in very minor, and mostly indirect environmental impacts. Overall, there are no significant impacts attributable to the proposed action or alternative action.

4.1 LAND USE

4.1.1 Criteria for Determining Significance

Information collected for Section 3 has been reviewed in relation to each alternative in order to assess the potential environmental or socioeconomic consequences of the action. Potential impacts on land use are considered significant if it is determined that the action is incompatible with surrounding land use, or if the action occurs on or adjacent to non-military lands and is inconsistent or in conflict with the applicable environmental goals, objectives, or guidelines of a community, county general plan, or other applicable federal or state agency land use plan for the area affected.

4.1.2 No Action

The existing land use pattern is a result of the various mission changes and facilities management at the installation during more than one hundred years of history. Adaptations to mission changes have had an impact on land use relationships when sporadic facility siting either confined expansions of existing land use zones and/or forced major functions into split locations (Zillgens 1991a). Under no action, this existing land use pattern will continue to inhibit future long-range planning necessary to meet mission requirements.

Should the No Action alternative be selected, the three RPMP component updates (LRC, SRC and CIS) would not be approved. Any existing land use conflicts identified in the LRC within the cantonment area would likely continue. Land use improvements in the cantonment area would not be programmed.

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Over the years, immediate needs for floor space related to the changing structure of operational activities has created a condition in which a number of buildings are being used for purposes other than originally intended. Under no action, this activity would continue to impact long-range planning efforts and could create incompatible land use zones. These incompatible zones result in a scattered facilities system that burdens the infrastructure and decreases the resource efficiency of the installation.

An example of incompatible land use patterns that would continue to exist under the no action alternative would be the continued operation of the Ammunition Supply Point at the current site in close proximity to a family housing Subdivision. The location of the existing ASP is incompatible with surrounding land use because portions of its Quality Safety Distance (QSD) clearances overlap Bonnie Blink subdivision's land use zone. This incompatible land use pattern occurs along the southern perimeter of the cantonment area and a public highway (Zillgens 1991a). Under no action, there is a safety concern due to the existing ASP location and the existing route vehicles must follow when transporting ammunition to and from the ASP

Several land use zones within District A are incompatible with each other and result from the reuse of temporary facilities to meet urgent space requirements. Moderate land use incompatibility exists between troop housing and maintenance land use zones west and east of Cushing Street.

Under no action, RV space will be insufficient to serve the demands of potential recreation users including installation personnel, retired military personnel, and personnel traveling throughout southern Arizona in a leave or permanent change of station status. The existing facilities are not anticipated to fully meet customer demands. Military-related recreational users are currently often required to travel extended distances for other RV facilities.

4.1.3 Proposed Action

If the LRC update were approved, there would be an increased probability that conflicting land uses identified in the LRC would be corrected and improved as facility demolition and replacement construction occurs. For example, the existing maintenance facility for the 11th Signal Brigade is located near personnel barracks. This is a sub-optimal condition since noise and fossil-fuel emissions from the maintenance facility are in close proximity to residential housing and community facilities. Under the LRC update, such industrial land uses and facilities would be programmed for construction in areas more in keeping with industrial activities. Under the Proposed Action Alternative, any new maintenance facility for the 11th Signal Brigade would likely be located in an area identified for future industrial use in the LRC rather than near a residential area. In another example, the quantity-safety distance (QSD) arc for the Ammunition Supply Point (ASP) impinges on the northwest corner of the Bonnie Blink residential area. The LRC update outlines plans to relocate the ASP away from personnel housing.

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Approval of the CIS and SRC would provide Fort Huachuca with programmed planning for MCA, NAF, and Host Nation Construction, and projected Real Property Maintenance (RPM) work by comparing existing real property to projected real property needs and other developmental or operational activities. Indirect positive impacts associated with the approval of the CIS and SRC component updates would occur as the likelihood that existing land use incompatibilities and facilities deficiencies would be corrected as ongoing facilities demolition and replacement construction occurs.

Authorizing steps leading to project implementation would establish a framework for managing limited financial and real property resources. It would help ensure that the installation has the real property assets necessary to support assigned missions and accommodate potential future mission requirements. In short, authorizing steps leading to project implementation would also allow Fort Huachuca to determine real property deficiencies and evaluate alternatives to satisfy these deficiencies. It would also allow Fort Huachuca to formally program preferred solutions to satisfy real property requirements and develop programming actions for prioritization and approval. Implementation of the proposed action would have no significant impact to land resources. Indirect positive impacts would be beneficial for future master planning activities.

4.1.4 Approve the LRC Update but not the SRC and CIS updates

Should this alternative be implemented, the land use improvements and installation land use requirements identified in the LRC update would be approved but not programmed. As demolition projects evaluated under separate NEPA documentation occur (ENRD 1998a), the resulting land vacancies could be placed under more compatible land use designations. However, approval of the LRC component update without the corresponding approval of the CIS and SRC and authorization of the steps leading to project implementation would mean that project funds related to such compliance improvements may not be available through the normal DoD planning process. Failure to approve the CIS and SRC component updates could slow implementation of corrective land use compatibility measures or, cause implementation to occur in an ad hoc, inefficient fashion. Implementation of this alternative would have no significant impact to land resources.

4.2 SOCIOECONOMIC

This socioeconomic impact analysis examines the potential impacts if the proposed projects are implemented.

4.2.1 Criteria for Determining Significance

Economic impacts to the region are predicted through the application of a set of standard models developed by COE CERL. These models are designed to provide data relative to the socioeconomic impacts of relocating military units with regard to mission changes and operations, construction activity, and training activities. These models are available to government and non-government users through the CERL

Economic Impact Forecast System (EIFS). Potential environmental justice impacts are also assessed as to whether the proposed activity results in disproportionately high adverse human or environmental effects to minority or low income populations.

4.2.2 No Action

Under no action, Fort Huachuca will continue to exert a positive economic impact on communities in Cochise County and the surrounding region, creating direct and secondary employment for approximately 40 percent of the county population. The presence of Fort Huachuca and the economic opportunities it provides contributes in excess of $500 million per year to the local economies in Cochise County. It is not currently possible to adequately and accurately differentiate the influence of the installation on local population increases and economic activity from other factors. Currently, communities in the region continue to grow and prosper relatively independently of the reduction in employment at Fort Huachuca.

Various steps leading to project implementation would not occur. Funding for the projects identified in the SRC would not be requested and the projects would not be approved as currently programmed. DoD funding would likely be directed to other priorities and other DoD locations and communities would benefit. The Fort Huachuca-Sierra Vista area would not receive the economic benefits associated with the funding for project improvements.

4.2.3 Proposed Action

Approval of the three RPMP component updates would allow Fort Huachuca to establish a framework for managing limited financial and real property resources and ensure installation management is compatible local community development.

The three RPMP component updates were completed in September 1997. No additional personnel or authorized positions are required to approve and carry out the steps which may lead to individual project implementation.

Under the Proposed Action Alternative, other DoD facilities may receive less funding, resulting in lower expenditures and a minor reduction in the economic activity in the communities supporting these other DoD locations. Because of the complexities of DoD budget allocations, it is not possible to quantify this impact nor identify specific facilities where this impact may occur. However, given the size of Fort Huachuca projects compared to the overall DoD budget and the number of DoD facilities around the world, it is reasonable to conclude that the impact at any given facility would be negligible and not significant.

There are no significant direct or indirect impacts to any human populations that would result from the proposed action. There are no impacts to minority or low-income populations as a result of the proposed action, and therefore no disproportionately high or adverse impacts to minority populations or low-income

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populations. Therefore, there are no significant impacts to minority populations and low income populations associated with the proposed action.

4.2.4 Approve the LRC Update but not the SRC and CIS updates

No significant impact is anticipated to result from the approval of the LRC but not the SRC and CIS updates. Conditions would remain similar to the no action alternative described in Section 4.2.2.

4.3 CULTURAL RESOURCES

4.3.1 Criteria for Determining Significance

Information was evaluated in relation to each alternative in order to assess the potential environmental consequences of each action. Potential impacts to cultural resources are considered significant if they will (or might reasonably be expected to) disturb or damage cultural resources and/or cultural resource sites.

4.3.2 No Action

Under no action, current levels of impacts on cultural resources will continue to result from operations, public access, the impacts of flooding and other natural events, and the natural gradual deterioration and degradation to which all artifacts and structures are subject. Within the National Historic Landmark and other older districts in the developed cantonment area, deferred maintenance and deterioration over time constitute the greatest potential to impacts to historic buildings. Although substantial resources have been devoted to rehabilitating and stabilizing structures within the historic landmark district, some of the structures may be at risk (Murray 1996).

Outside the cantonment area, training-related activities can have significant impacts on archaeological sites, particularly those sites that have not been identified and placed off limits. While only about 40 percent of the installation remains unsurveyed and much of that is in relatively inaccessible mountain terrain, surveys may have missed other sites with no current surface expression (Murray 1996). Even with the operational controls in effect, some continuing impact from training activities (maneuver, live fire, bivouac, and/or equipment testing) can be expected to continue under no action.

Other risks to archaeological sites include flooding, silt deposition, erosion, wildfire, burrowing animals, insects, roots, civilian recreational damage, and vandalism. These will continue under no action. The Post Archaeologist will continue to focus the available funding and volunteer resources on prevention and mitigation of these impacts. Generally, cultural resource sites on the installation are in better condition than those in the surrounding area. Fort Huachuca's stewardship of its cultural resources is very good,. however, limited resources will always be a major constraint. Fully arresting or reversing the natural and human-caused deterioration at most of the sites will not be possible under the current fiscal constraints.

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4.3.3 Proposed Action

There would be no significant impact to cultural resources because there are no demolition, construction, or other ground or property disturbing activities associated with the proposed action. Conditions would remain similar to the no action alternative described in Section 4.3.2.

4.3.4 Approve the LRC Update but not the SRC and CIS updates

There would be no significant impact to cultural resources because there are no demolition, construction, or other ground or property disturbing activities associated with this alternative. Conditions would remain similar to the no action alternative described in Section 4.3.2.

4.4 AIR QUALITY

4.4.1 Criteria for Determining Significance

Information was evaluated in relation to each alternative in order to assess the potential environmental consequences of each action. Potential impacts to air quality are considered significant if actions degrade air quality beyond compliance with current federal and/or state regulations or NAAQS.

4.4.2 No Action

The installation is in compliance with all federal and ADEQ air quality regulations. Additionally, energy conservation and alternative energy programs in use by the installation reduce fuel usage and thus the production of air pollutants.

4.4.3 Proposed Action

There would be no impact to air quality because there would be no new sources of emissions or air pollutants resulting from the proposed action. Conditions would remain similar to the no action alternative described in Section 4.4.2.

4.4.4 Approve the LRC Update but not the SRC and CIS updates

There would be no impact to air quality because there would be no new sources of emissions or air pollutants resulting from this alternative. Conditions would remain similar to the no action alternative described in Section 4.4.2.

4.5 NOISE

This section presents the environmental consequences of the no action and proposed action alternatives for the noise attribute of this DEIS. It is assumed that the reader has a basic understanding of noise metrics and

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models. A more detailed and instructive discussion of these factors and their application to this DEIS is presented in Appendix D: Noise Investigation.

4.5.1 Criteria for Determining Significance

The criteria for the assessment of the impacts of noise are based on established Land Use Compatibility Guidelines established by the Federal Interagency Committee on Urban Noise 1980: *Guidelines for Considering Noise in Land Use Panning and Control* and the Federal Interagency Committee on Noise 1992: *Federal Agency Review of Selected Airport Noise Analysis Issues.* The signatories of these sources of criteria include DoD, Department of Housing and Urban Development (HUD), EPA, FAA, and Veterans Administration. These agencies are in substantial agreement concerning the levels and characteristics of noise from different sources of noise on a wide variety of human activity and land use. The principal criteria used for this section include the ADNL 65 and cumulative daily noise level (CDNL) 62 dB levels as the thresholds for residential land use compatibility and the 1.5 dB incremental increase as the threshold requiring a more detailed assessment of noise impacts on a cumulative basis.

4.5.2 No Action

No action will result in noise production similar to what was measured in the ICUZ survey. Current activities will produce some increases in noise above the 1995 levels. An annual noise increase of 0.23 dBA (weighted dB) is predicted for the next five years. Pursuant to the noise element of the Sierra Vista Municipal Airport Master Plan (Coffman 1989), the ADNL 65 dB contours are expected to increase over the 1989 area by about three percent by the year 2010, or by about 0.20 dB. Noise levels in nearby residential areas generally will remain at or below levels that will be likely to result in widespread complaints by the public. Noise impacts on wildlife will not change significantly.

4.5.3 Proposed Action

There would be no noise impacts because no new noise producing activities are associated with the proposed action. Conditions would remain similar to the no action alternative described in Section 4.5.2.

4.5.4 Approve the LRC Update but not the SRC and CIS updates

There would be no noise impacts because no new noise producing activities are associated with this alternative. Conditions would remain similar to the no action alternative described in Section 4.5.2.

4.6 GEOLOGY AND SOILS

4.6.1 Criteria for Determining Significance

Information was evaluated in relation to each alternative to assess the potential environmental consequences of each action. Potential impacts to geology are considered significant if actions involve considerable

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excavation (e.g., mining) or alter surface water resources. Significant soil impact is based on the amount of soil disturbed and the relative importance of those soils.

4.6.2 No Action

An interagency agreement between the USFS Coronado National Forest and Fort Huachuca provides guidelines for cave management and protection on adjacent USFS and Army land. No mining currently takes place on Fort Huachuca and none is anticipated. Observance of modern geotechnical engineering practices will prevent significant impacts to local ground-water systems during routine construction and maintenance of roads and facilities.

Fort Huachuca is in a known (VII Modified Mercalli Scale) earthquake zone and in an area that experienced a severe earthquake (XI to XII MMS) less than one hundred years ago. An earthquake of similar magnitude today could cause major structural damage to buildings on Fort Huachuca, as well as landslides on unstable mountain slopes. Although earthquakes cannot be prevented, earthquake damage and human injury will be reduced by appropriate planning. Soil erosion would continue to occur. No additional impacts are anticipated for the no action alternative.

Under no action, the installation environmental and training staff would continue to take actions to reduce soil erosion on all areas of the installation. Existing and planned land management programs would be implemented as funding allows. The ITAM program and its component programs will play a central role in planning training exercises so as to minimize soil impacts and to promote the sustainable use of training areas.

4.6.3 Proposed Action

There would be no impact to geology or soils because there are no ground or property disturbing activities associated with the proposed action. Conditions would remain similar to the no action alternative described in Section 4.6.2.

4.6.4 Approve the LRC Update but not the SRC and CIS updates

There would be no impact to geology or soils because there are no ground or property disturbing activities associated with this alternative. Conditions would remain similar to the no action alternative described in Section 4.6.2.

4.7 HYDROLOGY AND WATER RESOURCES

4.7.1 Criteria for Determining Significance

Information was evaluated in relation to each alternative to assess the potential environmental consequences of each action. Potential impacts to hydrology and water resources are considered significant if actions contribute a net increase in the fort's subwatershed consumption or if surface water resources are adversely altered. This section evaluated the historical significance of water resource development at Fort Huachuca; considered the potential impacts of short-term surface disturbance, construction, and examined potential long-term impact of each action.

4.7.2 No Action

Recent Fort Huachuca data show declining annual water use. Based on Fort Huachuca (ENRD 1998b) and ADWR (1996) pumpage data, between 1988 and 1990, Fort Huachuca was responsible for between 23 to 29 percent of the annual cultural groundwater use in the local area (1988 and 1989 pumpage is the most recent peak of installation withdrawals). Since then, the installation's actual annual withdrawals have decreased (Table 4.7-1), and consequently, so has the installation's percentage of total subwatershed withdrawals. Additionally, it was recently discovered that the installation's treated effluent ponds have been contributing to aquifer recharge. Amounts are estimated to be between 400 and 700 acre-feet per year, and may have been recharging for twenty years, based on geophysical evidence and estimated from establishment of the ponds, local evaporation data and annual effluent treatment volumes.

Due to conservation and reuse efforts, and in the context of the anticipated personnel decreases, the net reduction in the installation's withdrawal of water from the local aquifer system is anticipated to continue. From the most recent high annual Fort Huachuca withdrawals of 3,200 ac-ft occurring in 1988 and 1989, Fort Huachuca has reduced its annual withdrawal 850 ac-ft to 2,355 and 2,357 ac-ft in 1996 and 1997, respectively (Table 4.7-1).

Table 4.7-1. Fort Huachuca Population and Water Use (Pumpage) History (Population Data is from 30 September of Each Year)

Year	Military Assigned	Employees[1]	Military Family Members Residing on Post	Water Use in Acre Feet
1997	5703	4413	4734	2,357
1996	5,670	4,613	5,027	2,355
1995	5,854	5,010	4,978	2,428
1994	7,533	5,779	5,108	2,568
1993	5,823	5,430	4,930	3,028
1992	5,682	5,944	4,760	2,846
1991	5,914	5,506	4,775	2,709
1990	6,448	5,671	4,897	2,747
1989	6,440	5,802	4,891	3,207

Source: ENRD 1998b
[1]Represents DoD civilian workers and non-DoD civilian workers on Fort Huachuca.

The regional water consumption associated with installation employees is also expected to decrease with the current decreasing trend in personnel and other water use reduction measures.

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Under no action, no water would be used associated with the construction of facilities projects and no benefits would be gained (e.g., installation of water efficient amenities and increase in effluent reuse/recharge). No short or long-term increase in water use by Fort Huachuca personnel would be expected. The increased demand for groundwater resources in the subwatershed would likely continue independent of the installation. Although the Army can control the number of employees associated with Fort Huachuca, the Army has no control over civilian migration to the area. It is projected that regional water use would increase despite Army actions.

4.7.3 Proposed Action

No personnel will be hired nor will any additional positions be authorized at Fort Huachuca as a result of the proposed action. No additional domestic or other water use is anticipated as a result of the proposed action. Therefore, no impacts to water resources beyond those of the no action alternative are anticipated to result from the proposed action.

4.7.4 Approve the LRC Update but not the SRC and CIS updates

No personnel will be hired nor will any additional positions be authorized at Fort Huachuca as a result of this alternative. No additional domestic or other water use is anticipated as a result of this alternative. There would be no impact resulting from the approval of the LRC but not the SRC and CIS updates. Conditions would remain similar to the no action alternative described in Section 4.7.2.

4.8 BIOLOGICAL RESOURCES

4.8.1 Criteria for Determining Significance

An inventory and review of existing scientific information and data was used to evaluate potential impacts. The method relied on best existing information. The potential sources of and types of disturbances were identified. In addition, the extent, size, frequency, and duration of the disturbance was estimated. The types and location of biological resources were identified through review of survey reports, published literature, and previous impact evaluations. Next, the sensitivity of key biological resources (e.g., protected species, species important to ecosystem function, and sensitive and unique habitats) to the types of disturbances was evaluated based on past research and observational data. The location and timing of disturbances was then overlaid with locations of habitat and resources to determine what biological resources may be disturbed. The extent and magnitude of impact was estimated by comparing the type, size, and duration of disturbances with how the same type of resource responded in studies or other settings.

4.8.2 Terrestrial Habitat / Vegetation

Terrestrial habitat impacts resulting from no action or the proposed action may include direct vegetation destruction from construction activities, as well as vegetation enhancement from improved management.

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4.8.2.1 No Action

There would be negligible to low impacts to vegetation under the no action alternative from administrative, RDT&E, and training activities. Virtually all administrative activities would be confined to the cantonment and to office activities. Therefore, no impact to vegetation would occur.

RDT&E and activities would continue to occur both on Fort Huachuca and on locations off-post. Negligible impacts to vegetation would occur from the approximately 200 tests that would be conducted annually supporting the EPG tests and TEXCOM IEWTD tests. Test sites are near other developments and roads and the sites are gravel, paved, or otherwise previously disturbed sites with little or no vegetation. Movement of equipment on and off the sites would be via existing roads. Some marginal vegetation trampling may occur by personnel during testing of equipment. However, this would be an infrequent occurrence as most personnel would remain immediately around the equipment and have no reason and limited time to walk in any native undisturbed vegetation surrounding any of the test sites. Hazardous substances would not be used on the sites, therefore, no contamination would occur.

No or negligible impacts would result from continued JITC and Multi-Organizational Test Programs RDT&E activities. These activities would be bench-scale tests and conducted in existing facilities on Fort Huachuca. Personnel conducting tests would use existing roads and facilities. Use of hazardous materials would remain at current levels. Therefore, the risk of releases into the environment would be negligible and no impact to biological resources would result. These on-going tests would be conducted in existing facilities and operating areas.

Training would continue at current levels. Under the no action alternative, vegetation loss would be negligible or low because existing trails would be used and these trails are already devoid of vegetation. However, vegetation along the edge of the trails may be further impacted as trails are used. Highly impacted vegetation would be revegetated under ITAM and other programs.

Weapons training may also result in a limited increase in soil and vegetation disturbance in the South Range. Impact areas and weapon ranges are already present. As discussed, soil erosion would continue on the training lanes. The vegetation would serve as a sieve to collect the sediment and prevent its entering the San Pedro River during storm events.

Accidental fires are associated primarily with weapons training, and therefore, primarily initiated in impact areas of weapon ranges. The installation maintains firebreaks and has fire fighting capabilities on-call during weapons training.

There would be no impact to vegetation along the San Pedro River system under no action. No direct activities would occur within the San Pedro River system. Water use by Fort Huachuca under the no action would be about 2400 ac-ft /year. This would represent about 4.4 percent of total 56,820 ac-ft of annual flow of the San Pedro River. San Pedro River stream flow is highly variable with 10 year averages ranging from about 28 cfs in 1990-1996 to 55 cfs in 1970. This high variability (about 50 percent) is much greater than the 4.4 percent represented by use by Fort Huachuca. Therefore, impacts from Fort Huachuca water use (if current assumption about groundwater connectivity with the San Pedro River is valid) could not be measured or separated from natural variability. In addition, several of the modeling studies of the San Pedro River suggest that recent drought conditions along with declining agricultural water use are more important factors in determining changes in the San Pedro River flow (see Appendix A).

4.8.2.2 Proposed Action

There would be no impact to terrestrial habitat or vegetation because there are no demolition or construction activities or other ground disturbing activities associated with the proposed action. Conditions would remain similar to the no action alternative described in Section 4.8.2.1.

4.8.2.3 Approve the LRC Update but not the SRC and CIS updates

There would be no impact to terrestrial habitat or vegetation resulting from the approval of the LRC but not the SRC and CIS updates because there are no demolition or construction activities or ground disturbing activities associated with this alternative. Conditions would remain similar to the no action alternative described in Section 4.8.2.1.

4.8.3 Aquatic Habitat / Organisms

4.8.3.1 No Action

Direct and indirect impacts to riparian areas, ephemeral streams, intermittent streams, and perennial streams on and off post would be negligible to potentially beneficial. Likewise, direct and indirect impacts to aquatic biota, including sensitive and federally protected species would be negligible to potentially beneficial.

Direct and indirect impacts to ephemeral streams on Fort Huachuca would be negligible to minor. The ephemeral streams on Fort Huachuca are predominantly isolated from activities that could be damaging to the habitat and biota. Indirect impacts will also occur from sedimentation from soil erosion that results from surface soil disturbance due to ordnance, vehicle traffic, or construction activities. There would be negligible impacts to ephemeral streams in the South Range from training or recreation activities.

Direct impacts on perennial streams on Fort Huachuca and off post would be negligible. The perennial streams on Fort Huachuca are fairly isolated from activities that could be damaging to the habitat and biota. Direct and indirect impacts on springs would be negligible, with the exception of damage, from such causes as sedimentation, which may result in the aftermath of a catastrophic wildfire.

Direct and indirect impacts on riparian areas on Fort Huachuca would be negligible because most of the areas are located away from sites where potentially destructive activities usually take place. Direct impacts to riparian areas would consist of destruction of riparian vegetation by operational activities. Direct and indirect

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impacts on riparian areas off post would continue to be negligible under no action since no operational activities occur in or adjacent to riparian areas off-installation with the possible exception of those testing and training activities covered under separate NEPA documentation. No impacts on wetlands are expected because of the remote location of wetlands from activity areas.

Direct impacts to aquatic biota would be negligible at Fort Huachuca. Trout would continue to be stocked on Fort Huachuca for recreational fishing, but not in the upper Garden Canyon area. Direct and indirect impacts to aquatic biota off post are not anticipated to be significant. (see cumulative impacts section).

Direct and indirect impacts may potentially occur to the Huachuca springsnail, Ramsey Canyon leopard frog, Sonoran tiger salamander, and Huachuca water umbel. These species are known to be present in habitats on the South Range. The Huachuca springsnail has stringent habitat requirements and is therefore susceptible to direct impacts from incidental recreational activities disturbing their habitat. The Huachuca springsnail would also be likely to suffer from direct and indirect impacts of wildfires.

4.8.3.2 Proposed Action

There would be no impact to aquatic habitat or organisms because there are no demolition or construction activities or other ground or stream disturbing activities associated with the proposed action. Conditions would remain similar to the no action alternative described in Section 4.8.3.1.

4.8.3.3 Approve the LRC Update but not the SRC and CIS updates

There would be no impact to aquatic habitat or organisms resulting from the approval of the LRC but not the SRC and CIS updates because there are no demolition or construction activities or other ground or stream disturbing activities associated with this alternative. Conditions would remain similar to the no action alternative described in Section 4.8.3.1.

4.8.4 Wildlife

Impacts to wildlife resulting from either the no action or the proposed action are similar and would result in negligible habitat loss, modification, and fragmentation.

4.8.4.1 No Action

Impacts from administrative activities would be negligible since virtually no wildlife resources are present in the cantonment where most administrative activities would occur.

Negligible to low impacts to wildlife would occur from the ongoing electronics testing that would be conducted annually. These tests occur on established sites, near other developments and roads. The sites are gravel, paved, or otherwise previously disturbed sites with little or no vegetation. Movement of equipment on and off the sites would be via existing roads. Therefore, wildlife habitat would not be disturbed. Hazardous

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substances would not be used on the sites, therefore contamination would be minimal. Presence of humans, noise, and night lights (if used) may temporarily disturb wildlife in immediately surrounding habitat. However, these sites are near other human activities or structures, such as roads, and therefore, not significantly additive to existing disturbance levels. Therefore, impacts from human presence, noise, and lights would be negligible or low.

Impacts from training would primarily result from noise from human presence, vehicles, and weapons training. As shown in studies, animals may temporarily or permanently move from areas. Since training would continue in areas where training has historically occurred, it is anticipated that wildlife would temporarily move away from the training activities but would not abandon the areas. Vegetation loss from vehicles would be minor because training lanes are existing and no other off-road driving is authorized. Similarly impact areas are present and previously disturbed. Therefore, habitat loss would be low.

Over the long term, additional habitat losses or habitat fragmentation could occur as a result of poor facilities siting due to lack of consistent land use planning as a consequence of the no action alternative.

4.8.4.2 Proposed Action

There would be no impact to wildlife because there are no ground or airspace disturbing activities associated with the proposed action. Potential future impacts to habitat may be reduced due to facilities siting and management within approved, compatible land use zones. Conditions outside of the cantonment area would remain similar to the no action alternative described in Section 4.8.4.1.

4.8.4.3 Approve the LRC Update but not the SRC and CIS updates

There would be no impact to wildlife because there are no ground or airspace disturbing activities associated with this alternative. Conditions outside of the cantonment area would remain similar to the no action alternative described in Section 4.8.4.1.

4.8.5 Federally Listed Species

4.8.5.1 Criteria for Determining Significance

An analysis was performed by an interdisciplinary team in 1998, which included hydrologists and biologists among other technical professionals, to determine the potential impacts of Fort Huachuca activities on federally listed species. The period of time covered by the analysis extended 10 years into the future, which is beyond the anticipated life of the master plan updates under the proposed action of this DEIS. That analysis was used as the basis for potential impact determinations in this section. Determinations of potential cumulative impacts to the species from that analysis are provided in Section 7.0. Additional detail on the species or specific definitions on the types of potential impacts, such as fire, direct mortality, etc. are provided in Appendix B.

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4.8.5.2 No Action

No federally listed plants or critical habitat are known to exist in the cantonment area or East Range. Listed and sensitive species are known in isolated locations on the South and West Ranges. These areas are generally isolated from recreational use and are not near training facilities, vehicle training areas, or ordnance impact areas. No significant environmental impacts are anticipated in those areas from the no action. Protective measures are taken for the Huachuca water umbel, which is found near recreational areas. All new personnel receive "Newcomer's Orientation" where educational information on protection of species and their habitat is provided.

No threatened, endangered, proposed, or candidate species are known to occur on the East Range. Soldier Creek and other ephemeral streams within the East Range, however, may serve as travel corridors for wildlife including protected species. No information is available to determine if these potential corridors are used and if used to what extent. Because no habitat is present and travel corridors probably would be used only on an infrequent basis, the potential for impact is low.

Some listed species are present on the West and South Ranges. Noisy small arms training and vehicle traffic and maneuvers would occur year round.

Mexican spotted owls in general have extremely sensitive hearing with audible frequency ranges ranking among the best high-frequency (0.4-9 kHz) hearing presently known in birds (Manci et al. 1988). American peregrine falcons and Mexican spotted owls have demonstrated adaptability to some noise levels/events. Observations were made of nesting spotted owls being overflown in Colorado. Owls did not respond or only turned their heads toward the sound even though the sound from the jet engines was greater than 90 dBA (Johnson and Reynolds 1996). A study on the impacts of noise from simulated sonic booms to seven species of nesting raptors, including peregrine falcons in Arizona (Ellis et al. 1991) found that raptor responses were limited to temporary flushing of adults from nests. The noise levels of the sonic booms in the study ranged from 112 to 151 dBP and did not reduce subsequent nesting success or territory occupancy.

The lesser long-nosed bat is not anticipated to experience significant environmental impact from small arms training on the South Range. No significant impacts to bats due to noise would be produced as a result of the proposed action. Similarly, roost sites for the bat on the West Range are in remote locations. Therefore, these sites are not anticipated to experience significant environmental impact as a result of implementation of activities under the no action alternative.

Noise from the launch of unmanned aerial vehicles would produce very loud ultrasound, overlapping the bat's hearing in a wide band of frequencies. The noise generated by the takeoff rockets ranged from 76 to 93 dB and was well above the minimal noise that triggers a response in the bat's auditory system (Howell 1992). Noise and presence of vehicles during training in the South and West ranges would be primarily during the day. The lesser long-nosed bat forages through the night. The remote possibility exists that vehicle collisions with the bat could occur at night. This is unlikely due to restrictions on vehicle movement on the ranges at night, and the bats' echolocation abilities. No significant impact on the lesser long-nosed bat is anticipated from the no action alternative.

Noise impacts to the endangered Sonora tiger salamander and candidate Ramsey Canyon leopard frog, which are known to be present in the West or South ranges, would be negligible because the distance from the noise source to known locations of these species would diminish sound levels to negligible levels.

Training-caused or other man-caused wildfires have the greatest potential to cause significant impacts on protected species. Potential impacts of fire to threatened and endangered species include direct mortality; direct destruction of nesting, wintering, or foraging habitat; and indirect destruction or degradation of habitat through post-fire flooding, erosion, and sedimentation. Burning of extensive agave stands may also result and impact the lesser-long-nosed bat. A plan is currently under development to reintroduce managed burns to reduce these damages.

Ordnance may also directly injure listed species. The probability of this occurring would be very low because of the limited amount of firings, the low quality of habitat in the impact areas and ranges, the presence of humans, and the distance from ranges and impact areas to known locations of protected species. Mitigations are in place to reduce impact on species.

Recreational use of Fort Huachuca is expected to continue at current or slightly increased levels. Over 30,000 bird watchers visited the South Range in 1995 (personal communication, Stone 1996). However, visitation of habitats used by Mexican spotted owls and peregrine falcons for nesting are difficult due to the remoteness of the locations.

No impacts to federally listed wildlife off-post would be anticipated from the no action alternative. No off-post habitat would be disturbed and testing and training activities would be limited to existing roads and built areas.

4.8.5.3 Proposed Action

There would be no additional impact beyond that of the no action alternative are anticipated to result from the proposed action. Conditions would remain similar to the no action alternative described in Section 4.8.5.2.

4.8.5.4 Approve the LRC Update but not the SRC and CIS updates

There would be no impact resulting from the approval of the LRC but not the SRC and CIS updates. Conditions would remain similar to the no action alternative described in Section 4.8.5.2.

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4.9 SAFETY

4.9.1 Criteria for Determining Significance

Significance is related to increases or decreases in human health safety and includes the potential for accidents, mortality, and disease.

4.9.2 No Action

The increased safety provided by facilities upgrades, especially construction of a new ASP would not occur.

4.9.3 Proposed Action

Land use improvements, if implemented, would improve human and non-human environments, resulting in less exposure of populations to existing industrial emissions and safety hazards. These direct positive safety impacts to the human environment would not occur unless and until the construction projects are actually relocated or built; this is beyond the scope of this DEIS. However, the indirect impacts associated with the planning process are beneficial to the safety and well-being of installation personnel. Safety problems are identified and plans are outlined which increase the probability that compatibility problems become rectified as facilities demolition and replacement construction projects or new construction projects are implemented.

4.9.4 Approve the LRC Update but not the SRC and CIS updates

There would be no impact resulting from the approval of the LRC but not the SRC and CIS updates. Conditions would remain similar to the no action alternative described in Section 4.9.2.

4.10 ENERGY

4.10.1 Criteria for Determining Significance

Total annual consumption of electrical energy and peak power demand is important in assessing the potential impacts from the proposed action. If the proposed action would create a significant increase in annual energy consumption or peak potential loading is calculated to exceed the capacity of the transmission lines and transformers, it is considered a significant impact.

4.10.2 No Action

Under no action, energy demand in all categories will remain mostly constant with fluctuations from seasonal weather variations expected. No significant impact on the distribution networks in southeastern Arizona is anticipated from the no-action alternative. Electrical energy and fuel consumption will continue at a rate comparable to the present baseline usage.

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4.10.3 Proposed Action

There would be no energy-related impact because there are no new facilities or changes to energy consumption activities associated with the proposed action. Conditions would remain similar to the no action alternative described in Section 4.10.2.

4.10.4 Approve the LRC Update but not the SRC and CIS updates

There would be no energy-related impact because there are no new facilities or changes to energy consumption activities associated with the approval of the LRC but not the SRC and CIS updates. Conditions would remain similar to the no action alternative described in Section 4.10.2.

4.11 WASTE MANAGEMENT

4.11.1 Criteria for Determining Significance

Significance is related to an increase or decrease in the amount and types of waste generated. The potential for producing hazardous or regulated waste is considered more important than municipal solid waste (MSW) or construction and demolition debris.

4.11.2 No Action

There would be no changes to waste management practices under no action and thus no additional impacts to the environment are expected. Continued reduction in installation population would result in less waste generation, especially MSW.

4.11.3 Proposed Action

Administrative actions which are required steps leading to the implementation of projects under the proposed action would result in the generation of additional office waste, primarily recyclable white office paper. The installation currently participates with the Sierra Huachuca Association for Retarded Citizens (SHARC) in providing bins for collection and recycling of office paper and aluminum cans in administrative areas on the fort. This program is anticipated to continue. There would be no significant impact in the area of waste management resulting from the proposed action. Conditions would remain similar to the no action alternative described in Section 4.11.2.

4.11.4 Approve the LRC Update but not the SRC and CIS updates

There would be no impact resulting from the approval of the LRC but not the SRC and CIS updates. Conditions would remain similar to the no action alternative described in Section 4.11.2.

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4.12 TRANSPORTATION

4.12.1 Criteria for Determining Significance

Information was evaluated in relation to each alternative in order to assess the potential environmental consequences of each action. Potential impacts to transportation are considered significant if an action increased traffic on adjacent roadways such that the roadway would need to be widened. A two lane roadway would need widening when total daily traffic exceeded 8,000 vehicles. Additionally, the impact was considered significant if the action resulted in a shortage of available parking spaces or jeopardized the safety of pedestrians.

4.12.2 No Action

The transportation infrastructure is sized for a larger working population (approximately 14,000) than presently working at Fort Huachuca (10,116 at the end of FY 97) (ENRD 1998b). The Army Audit Agency (AAA) audit for BRAC 95 (FTH 1996) determined this infrastructure to be adequate. The no action alternative would not increase traffic or other use of this infrastructure; thus, transportation impacts of the no action alternative would not be significant.

4.12.3 Proposed Action

There would be no transportation-related impact resulting from the proposed action. Conditions would remain similar to the no action alternative described in Section 4.12.2.

4.12.4 Approve the LRC Update but not the SRC and CIS updates

There would be no transportation-related impacts resulting from the approval of the LRC but not the SRC and CIS updates. Conditions would remain similar to the no action alternative described in Section 4.12.2.

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5.0 MITIGATION MEASURES

The proposed action alternative is to approve recent (1997) updates to three components of the Fort Huachuca RPMP (the LRC, SRC, and CIS) and to authorize steps leading to project implementation. The nature of the proposed action is planning and the adverse environmental impacts attributable to a planning process are minimal. Some DoD facilities other than Fort Huachuca may not receive project funding or would not receive such funding as early as requested should Fort Huachuca's project funding requests be authorized. There is no reasonable mitigation measure available to offset this impact. In Section 3, Affected Environment, a discussion is provided of the ongoing conservation measures being conducted by the installation.

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6.0 UNAVOIDABLE ADVERSE IMPACTS

The proposed action is to approve recent (1997) updates to three components of the Fort Huachuca RPMP (the LRC, SRC, and CIS) and to authorize steps leading to project implementation. Some DoD facilities other than Fort Huachuca may not receive some requested project funding or would not receive such funding as early as requested should Fort Huachuca's project funding requests be authorized. Since there is no reasonable mitigation measure available to offset this impact, the indirect impact is unavoidable.

6.1 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Irreversible commitments are resource uses that would affect nonrenewable resources such as soils, fossil fuels, and cultural resources. No additional resources would be required to conduct the planning and authorization activities under the proposed action. Thus, there are no irreversible or irretrievable commitment of resources associated with the proposed action.

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7.0 CUMULATIVE IMPACTS

Cumulative impacts are defined in the CEQ regulations (40 CFR 1500-1508) as those impacts attributable to the proposed action combined with other past, present, or reasonably foreseeable future impacts regardless of the source or agency causing them. Because there are few, if any, direct or indirect environmental impacts that would result from adoption of the proposed action alternative, in the strictness sense, there are no cumulative impacts associated with the proposed action.

However, there is a need to put the minimal impacts of the proposed action into a regional context. To that end, the cumulative impacts of past, present, and reasonably foreseeable future activities which have, are, and will continue to occur in the region regardless of actions at Fort Huachuca are described in this section. Thus, this section provides a "cumulative impact baseline".

7.1 METHODOLOGY

Analysis of a cumulative impacts baseline requires the evaluation of a broad range of information that may have a relationship to the no action, proposed action, and alternative action. A good understanding of the politics, sociology, economics, and environment of the region is key to this analysis, as is an accurate evaluation of factors that contribute to cumulative impacts. Therefore, the methodology employed in this section required the review of a range of recent references regarding regional events and trends; the review of political, legal, and socioeconomic changes and expected changes; and interviews with knowledgeable sources involved in day-to-day developments in the region. This broad information base was then narrowed to include those events and trends that impact or may reasonably be expected to impact the affected environment.

The cumulative impacts baseline is established using three primary reference frames: time, area of geographic concern, and dynamic trends (with respect to impacts, impact responses, and positive actions not resulting from impacts). Because political, economic, and institutional uncertainties in Mexico pose major potential risks (and possibly opportunities) with respect to the environmental health of the USPB, a brief discussion of legal and institutional issues in Mexico follows these discussions.

The first discussion of a major theme or trend will include most of the general descriptive information regarding that theme or trend. For example, while mining activity is referenced in the discussion of water resources and ecological resources, it is first introduced in the section on land use. Thus, the reader will generally derive the most information by reading sequentially through this entire section, rather than reviewing topical discussions randomly.

7.2 BACKGROUND

Fort Huachuca is located in an environmentally, economically, and institutionally dynamic region. Assessing a cumulative impacts baseline within this complex region, particularly with respect to "reasonably

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foreseeable future impacts", requires the evaluation of short-term and long-term trends, some of which are moving in opposite directions. These trends are also evaluated with respect to risks, impacts, impact management and mitigation, and positive steps that are in progress or planned that are not in response to a specific impact.

The environmental future of the installation and the surrounding area in southern Arizona is dependent not only on what happens in that region and within the United States, but also on what happens immediately across the border in Mexico and, for many migratory species, what happens to winter habitat even further south in Mexico and Central America. Because the USPB straddles the international boundary with Mexico, protection for the environmental resources of the immediate region is complicated by the institutional complexities resulting from treaty obligations, differing legal and socioeconomic systems, and cultural differences.

The most common environmental concerns voiced during the public scoping process for this document included questions about impacts on water resources (the San Pedro River, groundwater mining, water quality), ecological resources (particularly federally listed T&E species and their habitats), and population growth and economic activity (especially in the Fort Huachuca/Sierra Vista area). Each of these issues requires the evaluation of a larger geographic area than the area immediately surrounding Fort Huachuca. Other potential areas of environmental impact (noise and cultural resources) are quite limited in geographic extent, while the remaining areas of concern fall somewhere in between.

7.3 SUMMARY

Through careful planning, the Fort has experienced an overall decline in installation water use. In addition, several watershed improvement and recharge studies and biological resource management programs instituted for at-risk environmental resources have established favorable trends in the key areas of water resources, and ecological resources, as well as in other areas of potential impact. For the area immediately surrounding Fort Huachuca (essentially the USPB in Arizona), the short-term trends are also positive in the critical areas of water resources and ecological resources. Over the long-term, however, the continued population increase in region, which is occurring despite a decline in both population and employment at Fort Huachuca, clouds the picture with respect to water resources and, by extension, ecological resources. If off-post population, urban growth, and urban water consumption in the region continue to increase as projected, additional mitigative measures will be required in the region to protect the critical environmental resources. Such measures would continue a trend that has been firmly established over the last five years, but incremental gains will be increasingly costly and difficult to achieve.

Another risk to both the water resources and ecological resources of the region is posed by economic activities within the San Pedro River watershed in Mexico. Existing and planned mining activity (USGS 1996) could pose a direct impact to regional water quality. Ongoing expansion of mining activity in northern Mexico, combined with the possible development of at least one additional major mine within the basin, would result in major increases in water consumption upstream of the international border (USGS 1996).

Agricultural activities in Mexico along the San Pedro and its tributaries would also impact both water quantity and quality. Entities on the American side of the border that are concerned with the future of the region will have to work closely with their Mexican counterparts to prevent and/or mitigate any environmental impacts that may result.

Economic and population growth in the remainder of Arizona and Sonora, Mexico, will provide the larger context for the events in the immediate vicinity of Fort Huachuca. A buoyant regional economy supports the continued growth in the Sierra Vista area that is occurring despite the overall reductions in authorized strength at Fort Huachuca. This regional economy has assured the survival of communities such as Bisbee and Douglas, Arizona, despite the loss of major employers that once dominated those towns. This regional economy provides the foundation for supporting the individual communities, and may contribute quantitatively to cumulative impacts on environmental resources in the area of Fort Huachuca.

Another regional issue that presents significant environmental concerns is the intrusion of non-native or exotic species into the area and the accompanying displacement of vulnerable native species. Some disruptive exotics have shown the ability under current conditions to out-compete native species. These include fish species in the San Pedro River as well as grasses like buffel, Johnson, and Lehmann's lovegrass; bullfrogs; and tamarisk.

7.4 LAND USE

The significant land use trends within the USPB described in this section are essentially independent of the proposed action and alternatives, which, will make no significant contribution to cumulative land use impacts in the region in the reasonably foreseeable future.

In February 1998, Department of Defense funded a Department of the Army requested study on the future land use patterns and alternatives in the Upper San Pedro River Basin. The study is being managed by Headquarters, U.S. Army Training and Doctrine Command and the U.S. Army Construction Engineering Research Laboratory, and being performed by the Harvard Graduate School of Design. The purpose of the study is to determine the future land use patterns if local municipalities grow according to current land use designations and zoning, and provide alternative scenarios for development that take into account stakeholder and community values. These values would be expressed by alternate land use patterns that would then be available if municipalities chose to implement them. Alternate future patterns may include such diverse values as infrastructure cost reduction, riparian protection, wildlife corridors or recreational areas. Stakeholder values and baseline geographic information are being gathered at this time. Currently, identified stakeholders include state and federal entities. Non-government entities will be included in stakeholder sessions this summer. Reports from the study are anticipated in late FY 99 or 2000.

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7.4.1 Fort Huachuca

Within the boundaries of Fort Huachuca, significant progress has been made with respect to integrated land use planning and management. In addition to the updates of the three components of the RPMP itself, plans have been developed for natural resources, cultural resources, water resources, sensitive species habitats, and fire management. These plans are increasingly reflected in the management of the military operations and missions assigned to the installation. Further, the plans focus not only on avoidance or mitigation of harm, but also on actively improving Fort Huachuca's natural environment. Measured against either its own historic record or the quality of management of nearby environmentally significant areas, Fort Huachuca's current land use management is good, from an environmental perspective. Although specific formally planned actions require construction of projects within the installation, the overall contribution of Fort Huachuca to cumulative land use impacts is negligible. This trend is due to competent land use management.

7.4.2 Regional Area

Within the Sierra Vista area outside of Fort Huachuca, two environmentally positive land-use trends are pitted against a powerful long-term urban growth trend. Public and non-profit acquisition and restoration of habitat areas, combined with the decline in land dedicated to agriculture in the area, have created a very positive recent land use trend. With the exception of riparian areas along the Babocomari River, most of the highest-value habitat near Sierra Vista enjoys a substantial degree of protection. Although the trend toward additional acquisitions in the immediate area has slowed, efforts to improve management of the already protected lands are accelerating. The population increase of the Sierra Vista urban area, however, will continue to move urban boundaries into currently undeveloped areas. Thus, open space in the area that is not under protective ownership (BLM, USFS, Fort Huachuca, and The Nature Conservancy) is expected to experience continued urbanization. Fort Huachuca's improved land use practices, however, will make a positive contribution to cumulative impacts in the area of land use.

The most important factors affecting future land use in the USPB outside of the Sierra Vista area will be urban growth in and near Benson, mining activity in the Mule Mountains and Mexico, and future land use near the San Pedro and its tributaries in Mexico. Spurred by the planned opening of Kartchner Caverns State Park in 1998 (an attraction expected to significantly enhance the tourist appeal of the Benson area), as well as activity on the part of several land developers, the Benson area is experiencing increased development and will likely grow in the next few years. Such growth, independent from Fort Huachuca, would contribute to cumulative impacts in the USPB.

7.4.3 Mining

The entire San Pedro basin lies within a zone of high base-metal mineralization in Arizona and Sonora (USGS 1996). USGS confirms that major copper companies are actively exploring an area just south of the

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international boundary within the upper watershed of Rio Las Nutrias, an environmentally significant tributary to the San Pedro (USGS 1996).

Also within the San Pedro watershed, the major copper mine at Cananea is being expanded, and smaller mines are currently being developed in the Sierra Mariquita northwest of Cananea (USGS 1996). USGS also anticipates the future development of an additional copper deposit in the Mule Mountains near Bisbee (USGS 1996). Unless major increases in the price of metals occur, or unless breakthrough extraction technology improvements are developed, USGS does not anticipate any significant metal mine developments in the Huachuca, Whetstone, or Dragoon Mountains, although some mineralization and old mine workings are present (USGS 1996).

7.4.4 Mexico

Although increased mining activity is reasonably foreseeable in Mexico in the future, trends in other possible land uses in Mexico are less predictable. In September of 1994, a proposed park plan encompassing a significant portion of the San Pedro watershed was published by the State of Sonora Secretaria de Infrastructura Urbana y Ecologia and Centro Ecologico de Sonora (SIUE 1994). The plan overlaps with some of the most active mineral activity areas in Sonora and does not appear to currently have sufficient support for adoption.

Land ownership within the USPB in Mexico is more than half "ejido" (peasant cooperative ownership protected by Mexican law), with most of the remainder under private ownership. Current land uses, in addition to the mining activity described above, consist mostly of low intensity agriculture and grazing. At present, it is not possible to predict whether, when, and to what extent these lands may come under greater development pressure.

7.5 SOCIOECONOMICS

The significant socioeconomic trends within the region described in this section are essentially independent of the proposed action and alternatives, which will make no significant contribution to cumulative socioeconomic impacts in the region in the reasonably foreseeable future. Tables 3.2-1 and 3.2-2 in Section 3.2 show the key variables relating to Fort Huachuca's contribution to changes in cumulative socioeconomic impacts in the region.

7.5.1 Fort Huachuca

Table 3.2-6, Section 3, containing successive iterations of the ASIP for Fort Huachuca over the past five years, shows the changes in authorized strength for the installation. The table shows two key trends: First, projected authorization levels for the most recent ASIP decline over time. Second, and perhaps more important from a trend analysis perspective, each successive ASIP shows progressively lower personnel authorization levels. For FY98, for example, the 1992 ASIP anticipated more than 14,800 authorized personnel, while the 1996 ASIP anticipates just over 12,300.

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Table 3.2-7, Section 3, illustrates a relationship confirmed by data for other recent years. Actual employment at Fort Huachuca is consistently near 80 percent of the ASIP authorization levels. Thus, any comparison of current *actual* employment with ASIP *authorized* levels is both inaccurate and misleading. The clear trend for the last few years and for the foreseeable future is a reduction in both authorized and actual employment levels, with actual employment remaining about 80 percent of authorization. The socioeconomic contribution of Fort Huachuca to a cumulative impacts baseline is therefore declining, measured in terms of personnel, dependents, income, expenditures, and infrastructure demands.

The cumulative impacts of socioeconomic changes in the Sierra Vista area present quite a different picture. Despite the decline in employment and a decrease in the total economic contribution from the fort to the Sierra Vista area since 1995, the Sierra Vista area population has continued to grow at a rate of approximately two percent per year. Thus, the area is easily absorbing the decline in installation-related employment and income, with no noticeable reduction in overall employment and income growth rates.

7.5.2 Regional Area

Overall, Cochise County's population has begun to grow in this decade at a rate faster than that of Sierra Vista, reversing the trend established in the 1980s. In part, this new growth results from a strengthening of the regional economy. Another trend that is reflected in these statistics, however, is the recovery of communities like Bisbee and Douglas from the decline their economies experienced after the respective shut-down of mining and smelting activities. Douglas, for example, had a stagnant population in the 1980s, but has grown more than 10 percent in the first half of the 1990s (Arizona Department of Commerce 1995). This recovery trend, associated with the attractive natural setting and climate in southeastern Arizona, the availability of inexpensive housing, and a certain critical mass of public infrastructure, may also explain the growth of Sierra Vista this decade despite the decrease of Fort Huachuca's socioeconomic impact. Sierra Vista's current growth trends challenge the theory that the closure of Fort Huachuca would cause permanent decline in Sierra Vista so that pressure would be removed from the area's critical environmental resources. A more likely scenario would be a period of severe economic impact due to the loss of the fiscal contributions by the installation, followed by a rapid attraction of new economic activity and residents to the inexpensive housing and infrastructure of the community. This would most likely result in a new period of growth lagging several years behind the current curve.

New mining activity in the Mule Mountains or Mexico will likely result in significant increases in population and related economic activity in the region, particularly in Bisbee and Cananea. Tourism (focused on both the ecology and history of the area, as well as its attractive climate) will continue to contribute to increased cumulative socioeconomic impacts. The recent focus on ecotourism, both locally and regionally, and the planned opening of Karchner Caverns State Park in late 1998, have increased visitor interest in the area. The buoyancy and expansion of the overall regional economy undergird all of these more local trends to both soften the impact of local economic crises and reinforce the impacts of local growth forces.

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Population increase is most important over the long-term because it increases the stress on water resources, both quantitatively and qualitatively, and land use. These trends may indirectly place pressure on the critical habitats and sensitive species of the region through increased water use. This is a long-term trend,

7.6 CULTURAL RESOURCES

The USPB is an area rich in both prehistoric and historic cultural resources. Actions at Fort Huachuca make essentially no measurable contribution to the cumulative impact baseline in the larger region.

Fort Huachuca, with over 100 historical buildings on-post and important sites representing thousands of years of human habitation, faces problems similar to those of the surrounding region. These include protection, preservation, restoration, and interpretation needs, as well as impacts from gradual natural deterioration, erosion, fire, development, and vandalism. Fort Huachuca differs from most of the remainder of the region, however, in that its management efforts are better organized, somewhat better funded and sites are somewhat better protected from pilfering and vandalism.

7.6.1 Regional Area

Within Sierra Vista and the surrounding region, cultural resources are significantly more subject to damage from development-related activity, mining, agriculture, vandalism, and pot hunting than within the installation boundaries. Protection efforts off-post are spotty, ranging from good for some historic buildings and certain sites on the SPRNCA to very poor in other locations. Fort Huachuca's post archeologist contributes to archaeological and cultural resource awareness in the region by outreach efforts to school children, civic organizations, and participation with the Arizona Archeological Society.

7.7 AIR QUALITY

7.7.1 Fort Huachuca

Any use of vehicles contributes to air pollution. Future planned construction, if implemented, will lead to short-term increases in particulates. On the positive side, the declining overall installation employment, cleaner running vehicles throughout the region, and ongoing and planned energy efficiency programs indicate that, except for the shorter-term particulate impacts, the contribution of Fort Huachuca activities to cumulative impacts on air quality will continue to decrease.

7.7.2 Regional Area

In the Sierra Vista area, urban growth and increases in construction activity, vehicle miles, and fossil fuel consumption will increase the stress on air quality. In the long-term, the impacts on air quality could become substantial. Within the USPB, continued growth and the potential for increased mining (and possibly related smelting and power generation activities) may be significant factors affecting air quality in the future.

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7.8 NOISE

The proposed action and alternatives represent no change in overall noise levels in the Fort Huachuca/Sierra Vista area. Neither the proposed action nor alternative will make any significant contribution to cumulative noise impacts in the region.

7.9 SOILS

The contribution of the proposed action or alternatives to cumulative soil impacts in the region is not significant.

7.9.1 Fort Huachuca

At Fort Huachuca and in the surrounding region, soils are often thin, vulnerable to compaction and erosion, and therefore subject to significant damage from many human activities. Fort Huachuca has integrated soil protection planning into its overall operational management for the installation. Range management practices currently include avoidance of areas susceptible to erosion, limited maneuver activity when moisture conditions might encourage erosion or compaction, very limited off-road vehicle access, and periodic resting of maneuver and training areas to allow vegetation to recover. Future planned improvements include improved watershed management, additional erosion control activities, improved fire management, and restoration stream channels and arroyos. Under either the proposed action or alternatives, the condition of soils is expected to improve at Fort Huachuca due to these management practices.

Soil erosion is minimized on training areas at Fort Huachuca using a combination of erosion control techniques and regulation of activities on the ranges. Erosion control techniques implemented at the installation have helped reduce erosion and restore native plant communities. Activities on all ranges at the installation are regulated by Fort Huachuca Regulation 385-8: *Range Training and Operations*, and the range control officer to ensure the ecological stability of the area.

7.9.2 Regional Area

In the Sierra Vista area, continued urban growth, urban flood control management, and increased off-road vehicle use pose impacts to the soils of the area. These soils have already been damaged in many locations by historic grazing and farming activities. In the USPB, in addition to the established impacts of grazing and farming and the more recent impacts of off-road vehicles, mining and related activities have heavily impacted soils in affected areas. Within off-post protected areas like the SPRNCA, the Coronado National Forest, and Nature Conservancy preserves at Canelo Hills and Ramsey Canyon, serious efforts are underway to improve overall soil conditions and prevent further erosion. The NRCS also works with many ranchers and farmers in the area to protect their soils and prevent further erosion.

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7.10 HYDROLOGY AND WATER RESOURCES

Fort Huachuca's contribution to cumulative impacts on water resources has declined significantly in recent years. At Fort Huachuca, annual water use is declining. While the declining employment at the installation has contributed to this reduction, better management of water resources has been an even more significant factor. Programs in place or planned at the installation will ensure the continued reduction in water use.

7.10.1 Fort Huachuca

The proposed action supports steps leading to the programmed implementation of several projects that are important to Fort Huachuca's overall mission. For example, programmed planning for the expansion of the effluent re-use system and construction of state-of-the-art recharge basins are supported by the planning process and are incorporated into the proposed action. Due to conservation and reuse efforts, and in the context of the anticipated personnel decreases, the net reduction in the installation's withdrawal of water from the local aquifer system is anticipated to continue. From the highest recent annual Fort Huachuca withdrawal of 3,207 ac-ft occurring in 1988 and 1989, Fort Huachuca has reduced its annual withdrawal by approximately 850 ac-ft to 2,355 and 2,357ac-ft in 1996 and 1997, respectively. In recognition of its water conservation efforts, Fort Huachuca received the FY94 Federal Water Conservation Award.

Other regional water consumption decreases are anticipated from the Fort's mountain front recharge program; and the planned, though not yet funded, effluent reuse and recharge efforts. The cumulative regional impact of continued urban growth, however, could eventually negate the gains achieved through reuse and recharge programs. However, the contribution of Fort Huachuca to this potential problem is decreasing.

7.10.2 Regional Trends

Recent trends in water conservation and management in the USPB, particularly with respect to water resources and protection of habitat areas, have generally been favorable, with protective measures generally offsetting the impacts of regional population increases. The retirement of agricultural water use and aggressive plans to recharge, conserve, and better manage available water resources have substantially lessened the near-term impacts on the groundwater table in the Sierra Vista/Fort Huachuca area. The overall net reduction in personnel and dependents at Fort Huachuca, a result of downsizing and realignment, will also reduce water consumption, although this reduction may be small in the context of larger regional trends.

As concern about potential impacts to the stream flow and water quality in the San Pedro River have increased, much effort has been devoted to assessing the nature and extent of the impacts, as well as to developing and implementing plans to mitigate any adverse impacts. The City of Sierra Vista; Fort Huachuca; numerous federal, state and local agencies; and a large number of citizens and interest groups have been involved in this process. A significant amount of progress has been made, and substantial resources have been and are expected to continue to be devoted to these efforts. All of the actions

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described below are expected to reduce the stress on the aquifer and the riparian system as well as to reduce potential future impacts on water resources that may be used by endangered, threatened, and/or sensitive species.

7.10.2.1 Monitoring

Fort Huachuca, BLM, USGS, and The Nature Conservancy are participating in a local groundwater monitoring program to obtain critical data for refinement of ADWR's computer model of USPB water resources. Fort Huachuca records 50-day water level readings of on-post monitoring and test wells. ADWR manages on-post index wells. USGS records continuous readings of three monitoring wells. ADWR also prepares an annual compilation and analysis of modeling efforts. Subsurface geological studies to determine the physical characteristics of the groundwater basin on the installation and in the vicinity of the area are also in progress. More than $350K ($100K in 1995 and $250K in 1997) has been funded by Fort Huachuca for geophysical studies (gravimetric, magnetic, and seismic).

7.10.2.2 Preservation

Recognizing the importance of the Sierra Vista subwatershed of the USPB, The Nature Conservancy began acquiring key parcels for protection as nature preserves more than 20 years ago. The Nature Conservancy now has preserves at Dudleyville, Bushman Canyon, Ramsey Canyon, Aravaipa Creek, Muleshoe Ranch, and Canelo Hills Cienega within the San Pedro watershed. The Nature Conservancy also works with Mexican environmental groups and governmental agencies to try to protect the headwaters of the San Pedro River in Mexico. The USFS and Fort Huachuca have also taken important steps to protect the biological resources on lands they own. A few years after The Nature Conservancy became active in the region, the BLM began acquiring and/or designating already-owned lands for special protection, beginning with the Aravaipa Wilderness Area and later focusing on the perennial portions of the San Pedro River itself.

The BLM and The Nature Conservancy have worked together over the last decade to acquire and retire half the farming acreage along the San Pedro near Sierra Vista, thereby reducing agricultural water use by approximately 2000 ac-ft per year (TNC 1996). Sierra Vista has plans to recover half of its effluent. The City of Sierra Vista and local citizens' groups have worked with environmental groups and state regulatory agencies to develop a plan to recharge Sierra Vista's treated effluent between the city and the river, thereby augmenting groundwater that would buffer the projected expansion of the cone of depression toward the river.

7.10.2.3 Recharge

Efforts are underway to minimize any potential impacts of groundwater pumping on the San Pedro River and its riparian ecosystem. Sierra Vista received a grant from the Arizona Water Protection Fund in 1995, as well as Bureau of Reclamation funding, to establish a recharge project between Sierra Vista and the San Pedro River (TNC 1996). The goals are to augment flow to the river, prevent any expansion of the cone of depression toward the river, and to create a buffer zone between the river and the wells that provide water

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to Sierra Vista. (A cone of depression is the water-level decrease in the vicinity of a well or well field caused by groundwater pumping).

7.10.3 Mexico

7.10.3.1 Mining

Within the USPB, the most significant impacts to both water quantity and water quality are likely posed by the potential for major mining development near the headwaters of Rio Las Nutrias (a major tributary of the San Pedro) and the ongoing expansion of mining activity in the Cananea area and Sierra Mariquita. New mining activity in the Mule Mountains may also impact water resources for the San Pedro. This increased mining activity is either occurring or is expected to occur in the foreseeable future. A major new copper mine would be expected to consume as much as 10,000 ac-ft or more of water per year. Milling activities, tailings ponds, and use of petroleum products and other chemicals would pose an impact to both groundwater and surface water quality. In 1979, when the tailings containment structures at the Cananea mine were breached, the resulting contamination caused a die-off of fish and other aquatic species at least 100 kilometers downstream (USGS 1996). Copper mining is also often associated with sulfate contamination of groundwater.

7.10.4 Agriculture

Ejidos along the San Pedro are reported to be irrigating approximately 2,000 acres (3 sq. mi.) of land (SIUE 1994). Future increases in agricultural uses in Mexico cannot be ruled out and may in fact be a reasonable expectation, and any such use could contribute to cumulative impacts on both quantity and quality of water resources.

Urbanization in both the Cananea area and at points as far downstream as Benson could also contribute to cumulative impacts on the region's water resources. Over the long-term, the San Pedro River and the riparian habitat it supports are likely to be brought under additional pressure from some or all of these trends. The contribution of Fort Huachuca to the cumulative impact baseline will decrease over time.

7.11 BIOLOGICAL RESOURCES

In the larger regional and international context, Fort Huachuca's contribution to cumulative impacts on ecological resources is positive. Fort Huachuca serves as an incidental federal protectorate of several species of federally-protected threatened and endangered species and their on-post habitats.

7.11.1 Fort Huachuca

At Fort Huachuca, better information and active monitoring, management, protection, and enhancement programs have led to a stable, in some cases improving, outlook for ecological resources on the installation. Among the key programs that are being developed or are planned for implementation are the INRMP; Endangered Species Management Plans for species such as the Mexican spotted owl and lesser long-nosed bat; active management and protection of key sites like agave stands, bat roosts, springs, and owl nesting sites; participation in management and recovery programs for such species as the Ramsey Canyon leopard frog; erosion control; range management; and implementing a prescriptive fire program to improve habitat condition and avoid catastrophic wildfire. Fort Huachuca's water resources management program, which address both groundwater and local riparian concerns, will provide an important long-range contribution to the overall health of the region's ecological resources. The installation has an ongoing effort to address protected species and their habitats. In general, Fort Huachuca's contribution to undesirable impacts on ecological resources is diminishing, and its contribution to recovery of species populations and their habitats is increasing.

7.11.2 Regional Area

In the area near Sierra Vista, a very favorable recent trend affecting ecological resources has been established with the acquisition and improved ecological management of environmentally significant areas along the San Pedro River. Except along stretches of the Babocomari River, and with respect to acquisition of holdings within protected areas, only limited additional land acquisition may be necessary or feasible in the USPB in Arizona. Other protection tools like management agreements, conservation easements, habitat restoration, watershed restoration, erosion control, control of exotic species, and prescriptive fire will be more important to the ecological health of the region.

Cooperation among land management entities like BLM, USFS, Fort Huachuca, some participating local landowners, and The Nature Conservancy has resulted in some progress on important issues affecting the region's environment. Other entities such as the local Natural Resource Conservation Districts, USFWS, AGFD, ADWR, and Arizona's universities are also providing important assistance in this arena.

Multiple party cooperative environmental protection and enhancement efforts are increasingly important for the future environmental health of the region. Recent examples include species management agreements like that for the Ramsey Canyon leopard frog; land management agreements like that for the Muleshoe Ranch Cooperative Management Area; and habitat and species restoration plans like the reintroduction of beaver along the San Pedro River. These multiple party activities have shown promise in addressing the needs of individual species, protection of vulnerable habitat, overcoming jurisdictional issues among different agencies and interests, and identifying and addressing threats and problems that do not fit neatly within the scope of existing regulation and law. The success of such efforts, both within the San Pedro watershed in the United States and across the international boundary, will be critical to minimizing cumulative impacts on regional biological resources, particularly where cumulative impacts result from the additive activities of a number of different entities as is common in the region.

Fort Huachuca has entered into cooperative agreements ranging from fire management to the Ramsey Canyon leopard frog plan and has worked closely with other entities to develop accurate information regarding regional geohydrology and coordinate water resource planning. Such existing efforts and future similar efforts enable the installation to contribute to solutions to cumulative impacts even in circumstances

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where its contribution to those impacts is small or unclear. The proposed action and alternatives reflect existing policy at Fort Huachuca to work cooperatively with other entities.

One significant category of threat to biological resources on a regional basis involves intrusion of non-native or exotic species and their consequent displacement of native species. Among the larger regional exotic threats are non-native fish and amphibians; grasses like buffel, Johnson, and Lehmann lovegrass; and tamarisk (TNC 1996a). When combined with other significant threats like habitat destruction, alteration of stream channels, and overgrazing, the impact of competition from exotics has sometimes been devastating to sensitive species (TNC 1996). In general, however, the introduction and spread of exotics results from causes that are independent of Fort Huachuca.

Potential cumulative impacts to biological diversity in the region around the installation include degradation or loss of habitat, decreased stream flows, diminished water quality, human recreational impacts of human economic activities like land development or grazing, and direct or indirect damage from wildfires. Regional economic growth and Mexican mining activity constitute the most likely near-term contributors to increase in these impacts.

These same issues will also be important in Mexico, although establishing protected status for key lands within the San Pedro watershed and further south in winter habitat for migratory species will be a more important tool than in the United States. Cross-border partnerships and active involvement of Mexican governmental and non-governmental organizations in the protection efforts will be critical to their success. The combination of rapid population increases and a difference in political culture will continue to bring pressure to bear for actions that impact the environment. Some of these actions could substantially impact or even overwhelm protection efforts within the U.S.

One potential cumulative impact associated with regional population growth is from recreational activities in the Fort Huachuca/Sierra Vista region. These impacts would likely include increased recreation pressure on Fort Huachuca, the SPRNCA and adjacent National Forest. In addition to the human disturbance factor associated with recreation, increased recreation on Fort Huachuca and the SPRNCA may result in a higher risk of wildfire, which potentially impacts most wildlife including federally listed species in the vicinity. Other activities such as the potential for privatization of Fort Huachuca housing and utilities, and the potential for the construction of a veterans cemetery on the post, also contribute to regional cumulative impacts.

A second potential cumulative impact associated with regional population growth is the potential impact to groundwater resources and the resulting impact on aquatic species on Fort Huachuca and in the nearby SPRNCA. The population of Cochise County has increased by approximately 2.4 percent annually since 1990, following annual growth rates of 1.3 percent in the 1980s. The proportion of the county population attributable to Fort Huachuca has decreased since that time and is likely to continue as Fort Huachuca population decreases. The population growth attributable to state or private actions will continue to impact groundwater resources in the USPB if per capita groundwater usage rates remain at or near current levels,

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as they are expected to (ADWR 1996). Due to Fort Huachuca's successful groundwater conservation process, the contribution to cumulative groundwater impacts are decreasing relative to both historic fort use, and other uses in the region. Supporting evidence includes the following:

1. Water consumption at the installation has steadily declined due to an aggressive water conservation program and the use of treated effluent for irrigation. The annual amount of water pumped by the installation in 1997 was approximately 2,357 ac-ft.
2. Fort Huachuca's contribution to cumulative impacts on water resources has declined significantly in recent years. At Fort Huachuca, water use is declining. While the declining employment at the installation has contributed to this reduction, better management of water resources has been an even more significant factor.
3. Ongoing conservation measures and planned measures at the installation will ensure the continued reduction in water use.
4. The quality of the groundwater obtained by Fort Huachuca and other users in the USPB is within Arizona Department of Environmental Quality (ADEQ) standards, and ongoing and programmed future military operations and activities would have no impact on water quality.

There remains speculation regarding the possibility that the cumulative impact of groundwater use in the region may impact the SPRNCA over the long term. Current best scientific evidence indicates that groundwater use by Fort Huachuca is not anticipated to impact surface flows in the SPRNCA over the next 10 years. However, because of the potential for longer-term cumulative impacts to surface water flows in the SPRNCA resulting from groundwater use in the region, there is a need for further research to more clearly identify potential cumulative impacts and their environmental significance resulting from population growth and groundwater use on the SPRNCA beyond the 10-year horizon.

7.11.3 Federally listed species

An analysis was performed by an interdisciplinary team in 1998, which included hydrologists and biologists among other technical professionals, to determine the potential impacts of Fort Huachuca activities on federally listed species. The period of time covered by the analysis extended 10 years into the future, which is beyond the anticipated life of the master plan updates under the proposed action of this DEIS. The determination of impacts to the species from that analysis are provided in this section. Additional detail on the species or specific definitions on the types of potential impacts, such as fire, direct mortality, etc. are provided in Appendix B.

Several federally listed species are neither known nor likely to occur on Fort Huachuca or in the SPRNCA and there would be no cumulative impact to these species.

The Cochise pincushion cactus is neither known nor likely to occur on Fort Huachuca or in the SPRNCA. Similarly, suitable habitat is not present. The closest known populations are in the southeastern corner of Cochise County, Arizona and adjacent Sonora, Mexico (SFB 1996). Similarly, the Chiricahua leopard frog is not known to occur on Fort Huachuca or in the SPRNCA.

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Cactus ferruginous pygmy-owls are not known to occur in the vicinity of Fort Huachuca, but potentially suitable habitat exists near the installation in mesquite and cottonwood stands found along the Babocomari and San Pedro Rivers. This habitat is, however, on the extreme upper end of the elevations tolerance of the species. No direct activities or associated ground disturbance would occur in these areas under the proposed action. Erosion on the East Range would result in minimal sedimentation in the Babocomari or San Pedro Rivers and should not impact vegetation structure or productivity in these areas. The limited potential for accidental fires burning into these areas would remain similar to the no action alternative, and cactus ferruginous pygmy-owls potentially nesting in the vicinity of Fort Huachuca would not be affected.

Although aplomado falcons are not known to occur on Fort Huachuca and have not been documented in this area for the several decades, potential habitat exists in the open grassland and savanna vegetation types found on the eastern portion of the installation. No native vegetation would be disturbed under the proposed action, and aplomado falcons potentially nesting or foraging in the area would not be affected by loss of habitat. The potential for direct mortality due to collisions with vehicles or ordnance is slightly higher for this species as compared with species that occur in montane woodlands or riparian areas, but, the low densities at which aplomado falcons are likely to occur if they become reestablished at Fort Huachuca would reduce the risk of direct mortality to very low levels. Noise from military activity would occur in or near potential aplomado habitat; this disturbance would be infrequent but would produce high noise levels. No information is available regarding the response of aplomado falcons to noise, but previous studies on the impacts of aircraft noise on falcons and other raptors (Ellis et al. 1991) found that responses were short-term and minor, with no mechanism for long-term impacts to raptor populations.

The sensitivity of aplomados to human disturbance is unknown, but many falcon species tend to be sensitive to human presence during the nesting season. Prolonged or repeated disturbance can lead to nest abandonment and reduced reproductive success. The degree of overlap between potential aplomado habitat and operational activities may impact nesting falcons by causing repeated disturbance of nests. Accidental fires caused by operational activities could impact aplomado falcons if it burned into nesting areas or burned large areas of foraging habitat. However, the likelihood of large, uncontrolled wildfires on the eastern portion of the installation is limited due to low to moderate fuel loads.

Ocelots are neither known nor likely to occur on Fort Huachuca due to lack of suitable habitat. Limited habitat exists along the Babocomari and San Pedro Rivers in stands of dense mesquite, and ocelots may inhabit these areas if regional populations recover. No military activities would occur in these areas; therefore ocelot habitat would not be subject to ground disturbance, and the potential for direct mortality would be negligible. Erosion on the East Range would result in minimal sedimentation in the Babocomari or San Pedro Rivers and would not impact vegetation structure or productivity in these areas. No additional potential for accidental fires burning into these areas would occur under the proposed action, and no significant impact on would occur to ocelots potentially occurring in the vicinity of Fort Huachuca or their

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potential habitat. Cumulative impacts resulting from ongoing and programmed future military operations and activities by Fort Huachuca will not impact ocelots.

While Mexican gray wolves are being reintroduced into the region northeast of Fort Huachuca, this experimental population will not be allowed to expand out of the recovery area. Large wildfires that burn into areas could potentially impact wolf habitat through habitat destruction, but the risk of such a fire is very low.

No impact on the beautiful shiner, Yaqui chub, Yaqui catfish, and razorback sucker would occur from activities by Fort Huachuca because the only known populations of the species are outside of the region of influence of the proposed action.

7.11.3.1 Canelo Hills Ladies' Tresses

Primary threats to Canelo Hills ladies tresses are fire and loss of habitat through reduction of river surface flows. The Canelo Hills ladies' tresses is not known to occur on Fort Huachuca or the SPRNCA. One population of Canelo Hills ladies' tresses is located along the Babocomari River approximately 1.2 miles (3 km) northwest of Fort Huachuca and may be susceptible to any uncontrolled wildfire that could spread off-post. There is a low potential that a future fire could reach the river and the ladies tresses population. The potential for this occurring is low because of the distance the fire would have to travel, the moderate fuel load of the grassland communities between the fort and the river, and the implementation of fire suppression measures.

Groundwater use at Fort Huachuca is not anticipated to significantly impact the Babocomari River within the next 10 years. There is uncertainty about the potential for groundwater use on Fort Huachuca and in Sierra Vista to impact surface flows in the Babocomari River over the long term. The probability of groundwater use at Fort Huachuca contributing to the cumulative impacts on these bodies of water is low. Therefore, the potential cumulative impacts of population growth and groundwater use on the SPRNCA and the Babocomari River may impact, but no significant environmental impact on the species is anticipated. Ongoing and programmed future military operations and activities by Fort Huachuca are not anticipated to have significant environmental impact on Canelo Hill ladies' tresses species.

7.11.3.2 Huachuca Water Umbel

Primary threats to Huachuca water umbel populations are fire and erosion and the subsequent scouring of habitat during floods, loss of habitat through reduction of perennial stream and spring flows, and disturbance from recreational activities. Huachuca water umbel populations in upper Garden Canyon would not be affected by most administrative, training, or testing activities by Fort Huachuca. The limited training and testing activities that take place in the vicinity occur on existing roads and trails and are of short duration and intensity. Habitat loss due to ground disturbance may occur as a result of recreational activities. Disturbance from recreation activities may impact, but no significant impact to the species is anticipated.

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Wildfires have the potential to impact the Huachuca water umbel and other federally listed species in the Huachuca Mountains on Fort Huachuca. In presettlement times, fires occurred in the conifer forests in the Huachuca Mountains every four to seven years. Since the late 1800's, the fire frequency has been greatly reduced (Danzer et al 1996). The suppression of the natural fire frequency has lead to a build up in fuel loads, changes in tree species composition and density, and other factors which could lead to a rapidly spreading, stand-replacing fire (Covington and Moore 1992). These factors can result in negative impacts to aquatic resources (Rinne and Neary 1966) such as the water umbel. In addition, fire suppression activities have the potential to impact sensitive species and their habitat. Under current conditions, there is a chance that wildfires could occur in or near umbel habitat and if such a fire did occur, it could have an impact on the Huachuca water umbel. If prescribed burns are successfully carried out to reduce fuel loads in the woodland plant communities around and upstream of the water umbel populations, the potential for a major stand replacing fire would be greatly reduced. Under those conditions, a wildfire may impact but is not anticipated to have a significant environmental impact on the species.

The Huachuca water umbel is also located in the SPRNCA. Groundwater use at Fort Huachuca is not anticipated to significantly impact the SPRNCA within the next 10 years. If long-term flow reductions in the San Pedro River are proven to be linked to groundwater pumping at Fort Huachuca and this reduction is proven to degrade water umbel habitat conditions, then there may be a cumulative impact to the riparian vegetation of the SPRNCA, including the Huachuca water umbel. However, the potential for long-term impacts to surface flows is highly uncertain and a continued commitment to groundwater studies and identification of water conservation measures by Fort Huachuca would reduce the potential for significant impact.

Fires on the South and West Ranges are not likely to impact water umbels in the SPRNCA because of the distance and presence of fire breaks, roads and urban areas between the ranges and the habitat. However, Huachuca water umbel populations along the San Pedro River could be affected by fires caused by operations on the East Range if the fires burned into the SPRNCA. However, the probability of this occurring would be low, as previously discussed. No military activities would occur within the SPRNCA water umbel sites. Ongoing and programmed military operations and activities by Fort Huachuca are not anticipated to have significant environmental impact on this species.

7.11.3.3 Blumer's Dock

Primary threats to Blumer's dock populations are fire and disturbance from recreational activities. On Fort Huachuca, Blumer's dock is limited to a small area in an upper canyon. Although the location of the population in the upper portion of the canyon protects it from most training, testing, construction, or administrative activities, the area may be affected, by recreation activities. Under current conditions, wildfire could have an impact on this species. Fire may impact Blumer's dock populations on Fort Huachuca. However, if prescribed burns and fuel load reduction measures are successfully carried out, the potential of

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a major fire in Blumer's dock habitat would be reduced. Ongoing and programmed military operations and activities by Fort Huachuca are not anticipated to have significant environmental impact on this species.

7.11.3.4 Lemmon Fleabane

Primary threats to Lemmon fleabane populations are fire and disturbance from recreational activities. Lemmon fleabane is known to occur on two separate cliff faces in the high canyons, and may occur in similar habitat elsewhere on post. Although the location of the population in the upper portion of the canyon protects it from training, testing, construction, or administrative activities, the area may be affected by recreation activities. Infrequent unauthorized rock climbing has occurred in the vicinity of these populations, and has potential to impact this species. Disturbance from recreation activities may impact Lemmon fleabane. Measures to monitor and control recreation would reduce this risk. Wildfires have the potential to impact Lemmon fleabane. Potential wildfires resulting from recreational activities may impact Lemmon fleabane populations on Fort Huachuca, but this potential is determined not to be significant. Ongoing and programmed military operations and activities by Fort Huachuca are not anticipated to have significant environmental impact on this species.

7.11.3.5 Huachuca Springsnail

Potential impacts to Huachuca springsnails on Fort Huachuca include fire, direct mortality, disturbance from recreation activities, and erosion. The Huachuca springsnail is found near springs located on the South and West Ranges. These springs may be susceptible to direct impacts from recreation activities disturbing springsnail habitat. Recreation impacts would generally be infrequent and accidental, and may result in limited direct mortality of springsnails and the long-term impact of springsnail habitat. This activity may impact the springsnail due to human disturbance and direct mortality. Most potential impacts resulting from testing, training, construction, or administrative activities however, would not impact Huachuca springsnails because populations are isolated from activities that could be damaging. Although implementation of fuel load reduction and prescribed burns would reduce likelihood of a large wildfire, burning into spring areas may impact springsnail populations. Changes to spring flows and habitat damage due to subsequent post-fire flooding and erosion, may impact the Huachuca springsnail, but this potential is determined not to be significant. Ongoing and programmed future military operations and activities by Fort Huachuca are not anticipated to have significant environmental impact on this species.

7.11.3.6 Bald Eagle

Bald eagles are neither known nor likely to nest or winter on Fort Huachuca, and therefore no impact on the species is anticipated from operational, construction, or administrative activities on Fort Huachuca. Eagles occasionally winter along the San Pedro River adjacent to Fort Huachuca. They require large perching or roosting trees that could be affected by reductions in stream flows in the San Pedro River. Groundwater use at Fort Huachuca is not anticipated to impact the SPRNCA within the next 10 years. Ongoing and

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programmed future military operations and activities by Fort Huachuca are not anticipated to have significant environmental impact to this species.

7.11.3.7 American Peregrine Falcon

Potential impacts to peregrine falcons nesting or wintering on Fort Huachuca include noise, fire, and direct mortality. While the remote location of nests effectively eliminates the potential for direct mortality of nesting falcons, foraging peregrines could be struck by vehicles, aircraft, or ordnance. Most peregrine foraging activity likely occurs in woodland or riparian habitat. Since operational activities generally do not occur in these areas, direct mortality may impact the peregrine falcon.

Aircraft flight paths and associated noise contours are centered around LAAF and airstrips on the West and East Ranges. Noise contours exceeding 65 dBA are at least 26,240 feet (8,000 m) distant from peregrine nesting habitat. Noise from operational activities would be greatest for small arms firing on the South Range, blank firing on the West Range and mortar firing on the East Range. These activities could produce peak noise levels as high as 150 dBA at the noise source, but would attenuate to below 90 dBA over the 5,000 (or more) meters between firing points and peregrine nesting habitat. In addition, these noise events would be extremely infrequent. Noise from low-level jets and sonic booms has been found to have little impact on nesting peregrine falcons (Ellis et al. 1991). Birds appeared alarmed only for a brief period when noise stimuli was presented. The noise levels of the sonic booms in the study ranged from 112 to 151 dBP and did not reduce subsequent nesting success or territory occupancy.

Wildfires may potentially impact the peregrine falcon. Because peregrines nest on cliffs, fires would not likely damage the nest itself or result in direct mortality of adults or nestlings, but foraging habitat could be extensively degraded by a severe fire in the upper canyons. Therefore, under current conditions, wildfires may impact the peregrine falcon. However, if prescribed bums and other fuel load reduction activities are successfully carried out, the potential of a major fire in would be reduced. Ongoing and programmed future military operations and activities by Fort Huachuca are not anticipated to have significant environmental impact to this species.

7.11.3.8 Mexican Spotted Owl

Potential threats to Mexican spotted owls on Fort Huachuca include noise, fire, human disturbance, and direct mortality. Owls in general have extremely sensitive hearing with audible frequency ranges ranking among the best high-frequency (0.4-9 kHz) hearing presently known in birds (Manci et al. 1988). As with all raptors, the Mexican spotted owl is most sensitive to noise during nesting and to a somewhat lesser degree during foraging. A study on the impacts of noise from simulated sonic booms to seven species of nesting raptors (Ellis et al. 1991) found that raptor responses were limited to temporary flushing of adults from nests. The noise levels of the sonic booms in the study ranged from 112 to 151 dBP and did not reduce subsequent nesting success or territory occupancy.

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A study of a small number of Mexican spotted owls exposed to jet aircraft overflights found that owl responses did not exceed, and were typically less than, their responses to naturally occurring events (Johnson and Reynolds 1996). In a study of the impacts of helicopter noise on Mexican spotted owls, Delaney and others (1997) found that owls did not flush from nests and roosts when noise levels were below 92 dBA. The authors concluded that a management/protection zone of 105 meter-radius would minimize flush responses to helicopter overflights.

Mexican spotted owl nesting areas on Fort Huachuca are located at least 6,560 feet (2,000 m) distant from existing flight paths of helicopter, UAV, and fixed-wing aircraft operations. Aircraft noise levels at this distance would attenuate to below 90 dBA at nest sites, and should not result in flush responses by spotted owls. Noise from mortar firing on the East Range is at least 32,800 feet (10,000 m) from spotted owl habitat and would not impact Mexican spotted owls. Small arms blank ammunition firing on the West Range would not occur between 1 May and 1 October, which corresponds with most of the nesting and fledging periods of spotted owls in the Southwest (Stone 1994), and would therefore not impact nesting spotted owls. Noise from other testing and training activities would be attenuated to low levels (less than 65 dB) within a short distance from the activity, and would not impact spotted owls.

The suppression of natural fires in the wooded habitats on Fort Huachuca have created conditions where a major stand replacing fire could occur. Such a fire could result in severe damage to spotted owl habitat on Fort Huachuca. A wildfire could also result in direct mortality to young if it occurred during the nesting season. The potential exists that fire suppression measures such as constructing fire breaks could impact the spotted owls or their territories. Therefore, wildfires may impact the Mexican spotted owls on Fort Huachuca. However, if prescribed burns and other fuel load reduction activities are successfully carried out, the potential of a major fire would be reduced. Natural resource personnel would be available to work with fire fighting personnel to reduce the potential for fire suppression measures to impact the spotted owl.

While the remote location of nests effectively eliminates the potential for direct mortality of nesting owls, foraging owls could be struck by vehicles, aircraft, or ordnance. Most spotted owl foraging activity likely occurs in woodland or riparian habitat. Since operational activities generally do not occur in these areas, direct mortality is not likely to impact the Mexican spotted owl. Although the location of the most spotted owl protected activity centers protects it from training, testing, construction, or administrative activities, the area may be affected by recreation activities. Ongoing and programmed future military operations and activities by Fort Huachuca are not anticipated to have a significant cumulative environmental impact on this species.

7.11.3.9 Southwestern Willow Flycatcher

Potential threats to Southwestern willow flycatchers and critical habitat near Fort Huachuca include fire, erosion, and groundwater use. Southwestern willow flycatchers and their critical habitat within the SPRNCA would not be affected by direct mortality or human disturbance resulting from administrative, training, or testing activities by Fort Huachuca. No military activities occur within the designated SWF critical habitat near Fort Huachuca. Noise from military activities on the East Range would not impact the southwestern willow flycatcher because these activities are approximately 2 miles (3.2 km) from designated critical habitat.

There is a remote potential that wildfire on the East Range could escape fire suppression measures and spread into the SPRNCA. The probability of this occurring would be low because fires started on the East Range are rare, and there are no records of fires spreading to the SPRNCA. Potentially incendiary activities on the East Range would not increase over current levels. In addition, if a fire did start in the East Range, it would likely not spread far because of low fuel loads in the Chihuahuan desert scrub habitat, and aggressive fire management measures.

Erosion within the East Range is the highest on the installation, with sheet and rill erosion within the central portion of the range the most significant. While significant erosion and sediment transfer occurs across the East Range, the extent of deposition is predominantly limited to areas within Fort Huachuca and not in the adjacent SPRNCA.

Groundwater use at Fort Huachuca is not anticipated to impact the flow in the SPRNCA within the next 10 years. There is uncertainty about the potential for regional groundwater use to impact surface flows in the San Pedro River over the long term. If a direct relationship exists and it is proven that this relationship causes a degradation in flycatcher habitat, impact to southwestern willow flycatchers or their critical habitat may eventually occur. However, the potential for impacts to surface flows is uncertain and a continued commitment to groundwater studies and identification of water conservation measures by Fort Huachuca would reduce the potential for significant impacts. Without better understanding which leads to a resolution of regional groundwater issues, cumulative impacts from population growth and groundwater use in the region may impact southwestern willow flycatchers and their local critical habitat. Ongoing and programmed future military operations and activities by Fort Huachuca are not anticipated to have significant environmental impact on this species or its local critical habitat.

7.11.3.10 Lesser Long-Nosed Bat

Potential threats to lesser long-nosed bats on Fort Huachuca include fire, noise, direct mortality, and human disturbance. The lesser long-nosed bat is known to be sensitive to human disturbance, and disturbance during the post-maternity period may result in mortality or roost abandonment. Lesser long-nosed bat roost sites are protected by the fort, and electronic monitors record disturbances to the roosts from April through October, when bat species are most likely to be present. These electronic monitors and fences to keep recreational cavers out of caves are currently being improved, and are expected to be fully functional by late 1999 (Hessil 1998a). Caves are open to the public by permit for recreational caving from November to March, when most bats are not present. While lesser long-nosed bats use one of the bridges on the West Range as a night roost (Sidner 1997), there is no record or evidence of human disturbance at this site.

Howell (1992) studied the impacts of noise from UAV takeoffs on lesser long-nosed bats at Fort Huachuca. She determined that rolling UAV takeoffs at Pioneer and Rugge-Hamilton airstrips on the West Range may disturb foraging bats within one kilometer and recommended that night rolling takeoffs not be conducted from June to October when bats may be present. Howell found that rocket-assisted takeoffs (RATOs) produce very loud ultrasound, overlapping the bat's hearing in a wide band of frequencies. The noise generated by the takeoff rockets ranged from 76 to 93 dB and was greater than the minimal noise that triggers a response in the bat's auditory system. Again, she recommended that night RATOs not be conducted from June to October at Pioneer and Rugge-Hamilton airstrips. Day launches at these sites were not expected to disturb bats because of the distance between the airstrips and all known bat roosts (Howell 1992). UAVs may also be launched from Hubbard airstrip on the East Range, but should not present a noise problem because of its distance to agave stands and bat roosts (Howell 1992). Night maneuvering on the West Range would not occur between May and November.

Concentrated agave stands are protected, with restrictions on cross-country travel, pyrotechnics, and night use that are enforced by Range Control. Direct mortality and habitat loss are therefore highly unlikely. Travel corridors between roost and foraging areas for lesser long-nosed bats are largely unknown, however, and night activities in unprotected areas have a limited potential to result in direct mortality due to impacts of bats with vehicles.

Agave stands located near training areas are susceptible to accidental fire caused by operational activities. In addition, if fires spread into the upper canyons on the West Range, bat roosts could be impacted, potentially resulting in direct mortality of bats. Restrictions on travel and the use of potentially incendiary equipment during periods of high fire risk, combined with aggressive fire suppression policies, reduce the risk of fires in training areas. Wildfire is likely to impact this species. The use of fuel load reduction by prescribed burns (as discussed in Section 5) would reduce the potential for significant impact. Ongoing and programmed future military operations and activities by Fort Huachuca are not anticipated to have significant environmental impact on this species.

7.11.3.11 Jaguar

Although no confirmed sighting of a jaguar has occurred on Fort Huachuca, the availability of suitable jaguar habitat in the Huachuca Mountains suggests that the species may occur on the installation in the future if regional jaguar populations recover. Suitable habitat includes approximately 23,300 acres (36 sq. mi.) of oak-grass savanna, oak woodlands, mixed woodlands, mahogany woodlands, and conifer woodlands on the South and West Ranges. Proposed construction activities would not disturb these habitat types. Few operational activities take place in these areas; thus the potential for direct mortality would be limited to collisions with operational vehicles that infrequently travel these areas, or with recreational vehicles that use the large canyons more often. Recreational activity is not permitted beyond the cantonment area at night, when jaguars are most active, so the overall risk of jaguars colliding with vehicles would be negligible.

Jaguars may be affected by accidental fires that burn large areas of foraging habitat. Such fires could result in direct mortality, loss of foraging or denning habitat, and reduced reproductive success. However, with the

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enforcement of the fire prevention and suppression procedures, particularly in wooded habitat, direct mortality or loss of habitat for the jaguar is unlikely. In addition, the successful implementation of prescribed burns or other fuel load reduction activities in jaguar habitat would reduce the potential of a major fire and loss of potential habitat. Ongoing and programmed future military operations and activities by Fort Huachuca are not anticipated to have significant environmental impact on this species.

7.11.3.12 Jaguarundi

Unconfirmed reports suggest that the jaguarundi occurs within the SPRNCA, and suitable habitat for the species exists in this area. Erosion on the East Range would result in minimal sedimentation in the Babocomari or San Pedro Rivers and would not impact vegetation structure or productivity in these areas. The potential for accidental fires burning into these areas is not significant. Ongoing and programmed future military operations and activities by Fort Huachuca are not anticipated to have significant environmental impact on this species.

7.11.3.13 Sonora Tiger Salamander

Potential threats to Sonora tiger salamanders on Fort Huachuca include fire, direct mortality, human disturbance, and erosion. Loss of Sonora tiger salamander habitat is unlikely to occur from military activities because virtually all operational activities would occur at a minimum distance of 1.3 mile (2 km) from tiger salamander populations. The risk of direct mortality resulting from operational activities would be low because vehicle travel in the area is infrequent.

The known distribution of the Sonora tiger salamander at Fort Huachuca is limited to a single population. The potential impact of wildfire associated with ongoing and programmed future military activities is low. Potential impacts are limited to the low probability of a fire escaping and burning the upper canyons, thereby damaging potential habitat by destroying downed logs and other cover for terrestrial salamanders, and by causing erosion and siltation of tanks used as breeding areas. In an extreme fire, Sonora tiger salamander populations in nearby canyons could also be impacted. The successful reduction of fuel loads by prescribed burns and other fuel management activities in the wooded habitat in the upper canyons would reduce the potential for severe, stand-replacing wildfire. Changes to spring flows and habitat damage due to subsequent post-fire flooding and erosion, may impact the Sonora tiger salamander.

Under current conditions, recreational activities have the potential to impact this species due to incidental capture of individuals, crushing of terrestrial individuals by vehicles, driving through habitat, and the accidental introduction of bullfrogs or other organisms into the habitat. Ongoing and programmed future military operations and activities by Fort Huachuca are not anticipated to have a significant environmental impact on this species.

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7.11.3.14 Ramsey Canyon Leopard Frog

Potential threats to Ramsey Canyon leopard frogs on Fort Huachuca include fire, direct mortality, human disturbance, and erosion. Ramsey Canyon leopard frogs are currently known to occur in one pond on Fort Huachuca, with introduction into another pond possible under the Conservation Agreement signed by Fort Huachuca, USFWS, AGFD, USFS, and a private landowner. These populations would not be impacted by habitat loss, because activities that result in significant ground disturbance mostly occur in previously disturbed areas away from leopard frog populations. Direct mortality would be highly unlikely to occur as a result of operational activities, but has a potential to result from harassment or collection associated with recreational activities.

The sensitivity of Ramsey Canyon leopard frogs to noise is not known. Noise produced by small arms firing operations on the South Range would be the closest noise source to Ramsey Canyon leopard frog populations, and would be attenuated to a peak level similar to ambient noise at the ponds. This noise level would be further attenuated as the sound travels through the water of the pond.

The Ramsey Canyon leopard frog would likely experience an impact resulting if a severe fire burned into Tinker, Garden, or Brown Canyons. Wildfires have the potential to impact the Ramsey Canyon leopard frog resulting in ash and sediments to flow into their aquatic habitats. The successful reduction of fuel loads by prescribed burns and other fuel management activities in the woodland habitat would reduce the potential for severe stand reducing wildfire. Wildfire may also indirectly impact Ramsey Canyon leopard frogs on Fort Huachuca. Changes to spring flows and habitat damage due to subsequent post-fire flooding and erosion may impact the Ramsey Canyon leopard frog.

Under current conditions, recreational activities have the potential to impact this species due to incidental capture of individuals, driving through the habitat, and the accidental introduction of bullfrogs or other organisms into the pond. Ongoing and programmed future military operations and activities by Fort Huachuca are not anticipated to have a significant environmental impact on this species.

7.11.3.15 Yaqui Topminnow

Currently known only from a few ponds and springs in and near the San Bernardino NWR, the Yaqui topminnow does not now occur in the San Pedro River Basin, but it is possible that populations may be introduced into the area in the future. Current populations would not be affected by activities by Fort Huachuca because they are isolated from the San Pedro watershed. Ongoing and programmed future military operations and activities by Fort Huachuca are not anticipated to have a significant environmental impact on this species.

7.11.3.16 Gila Topminnow and Desert Pupfish

Known Gila topminnow and desert pupfish populations would not be affected by the proposed action because they are not known to exist on Fort Huachuca or in the SPRNCA. Gila topminnow and desert

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pupfish introductions in Buffalo Coral and Kino ponds on Fort Huachuca in the 1980s were unsuccessful, and successful future reintroductions are unlikely because of insufficient habitat requirements. Permanent water sources on the installation are too cold for the species. Ongoing and programmed future military operations and activities by Fort Huachuca are not anticipated to have a significant environmental impact on these species.

7.11.3.17 Loach Minnow and Spikedace

Potential threats to loach minnows and spikedace include fire, erosion, and groundwater use. Loach minnows and spikedace are neither known nor likely to occur on Fort Huachuca or in the SPRNCA. However, perennial reaches of the SPRNCA and Babocomari River have been identified as potential recovery habitat for these species (USFWS 1990). Any potential habitat for loach minnows or spikedace within the SPRNCA would not be affected by direct mortality or human disturbance resulting from administrative, training, or testing activities by Fort Huachuca.

Wildfire on the East Range could escape fire suppression measures and spread into the SPRNCA. However, the probability of this occurring is low because fires started on the East Range are rare and there are no records of fires spreading to the SPRNCA; potentially incendiary activities on the East Range would not increase over current levels. In addition, if a fire did start in the East Range, it would likely not spread far because of low fuel loads in the Chihuahuan desert shrub habitat, and aggressive fire management measures. Therefore, wildfires may impact potential loach minnow and spikedace habitat in the SPRNCA. Changes to spring flows and habitat damage due to subsequent post-fire flooding and erosion, may impact potential loach minnow and spikedace habitat if they are successfully reintroduced in the SPRNCA.

Groundwater use at Fort Huachuca is not anticipated to impact flows in the SPRNCA within the next 10 years. Therefore, continuing activities by Fort Huachuca are not likely to impact the loach minnow or spikedace or potential habitat if they are successfully reintroduced in the SPRNCA during this time. There is uncertainty about the potential for regional groundwater use to impact surface flows in the SPRNCA over the long term. If a direct relationship exists and it is proven that this relationship degrades the potential loach minnow and spikedace habitat, the species could be affected. However, the potential for impacts to surface flows is highly uncertain and a continued commitment to groundwater studies and identification of water conservation measures by Fort Huachuca would reduce the potential for significant impact. Without a regional commitment to understanding and resolving regional groundwater issues, cumulative impacts from population growth and groundwater use in the region may impact loach minnows and spikedace and their potential recovery habitat if they are successfully reintroduced in the SPRNCA. Ongoing and programmed future military operations and activities by Fort Huachuca are not anticipated to have a significant environmental impact on these species.

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7.12 SAFETY

7.12.1.1 Fort Huachuca

At Fort Huachuca, adoption of the proposed action would increase the probability that some safety concerns would be addressed. The SRC of the RPMP outlines several projects, which, if implemented, would improve safety conditions at the installation (see Appendix F for evaluation of impacts based on the assumption that the projects in the SRC are implemented).

7.12.1.2 Regional Area

In the Sierra Vista area, because of the reduction in vehicular traffic associated with the decline in installation employment, traffic safety and other employment-related safety impacts would be reduced. However, continued growth in the area, independent of the influence of Fort Huachuca, will likely result in increases in safety impacts over time. In general, off-post training and testing exercises will continue using the same leased locations as are used under baseline conditions, and the difference in frequency of use will not raise significant safety concerns.

7.13 ENERGY

In examining the potential cumulative impacts of the programs and facilities at Fort Huachuca on energy and natural resources, the most important consideration is the effect of supply and delivery of energy products in the region. The capacities of the primary delivery methods (trucks for mobility fuels, a pipeline for natural gas, and a high voltage transmission line for electricity) are adequate to satisfy the projected demand under either no action or the proposed action. Outside Fort Huachuca, there are no known new programs or facilities that will create new demand for energy products beyond routine commercial and residential growth. Energy consumption in the USPB is likely to increase due to continued population growth and the likelihood of future increases in mining activity, which tends to be energy intensive. Routine growth can be expected to increase demand by a modest fraction over the next five years. The current capacities of all energy delivery and production facilities are adequate to cover the projected demand of Fort Huachuca and of the expanding residential and commercial customer base through the next five years.

7.14 WASTE MANAGEMENT

The waste reduction trend established by conservation and recycling efforts and declining installation employment will lead to incremental reductions in the Fort Huachuca contribution to waste in the region. However, the region's population growth will probably lead to increased quantities of waste and increased cumulative impacts of related to waste management.

Within the USPB, urban growth and future mining activity probably represents the largest contributors to increases in cumulative waste impacts. Effective management of mine waste and tailings will be critical to maintaining water quality and the San Pedro River ecological resources.

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7.15 TRANSPORTATION

7.15.1.1 Fort Huachuca

The declining employment trend at Fort Huachuca provides a general background of easing traffic conditions within the installation boundaries.

7.15.1.2 Regional Area

In the Sierra Vista area, continued urban growth will lead to increased traffic and, most likely, increased congestion at some locations. This urban growth trend is largely independent of the general employment trend at Fort Huachuca. Outside of the Sierra Vista area within the USPB, urban growth and increased tourist traffic will likely be the greatest contributors to traffic in the foreseeable future. Any new mining activity will also be reflected in an increase in traffic.

7.16 Mexican Legal and Institutional Considerations

Except as otherwise noted, information in this section was derived from the US-Mexico Border XXI Program Framework Document and 1996 Implementation Plans (EPA 1996) or from an interview with University of Arizona Law Professor David Gantz (Gantz 1996). Because this discussion will be a very brief overview of a complex and rapidly changing legal environment, readers desiring more information on this subject should consult the above-referenced EPA documents, the North American Free Trade Agreement (NAFTA) environmental side agreement (NAFTA 1993), and the Commission for Environmental Cooperation.

Environmental law in Mexico has improved substantially in recent years, often reflecting the development of law and standards in the U.S. and sometimes even following the general structure of U.S. laws. For example, Mexico has a law similar to NEPA that requires the evaluation of environmental impacts of proposed new actions.

Enforcement of environmental laws in Mexico may be problematic. The economic downturn of the last two years has slowed progress toward full enforcement of the laws and regulations that are now in effect. Nonetheless, the overall trend in environmental protection law and enforcement remains positive. Newer facilities, particularly those associated with major foreign corporations, generally follow compliance standards that would be acceptable in the U.S. One possible exception to this tendency involves some government-owned facilities, like power plants.

A number of bilateral and multilateral treaties and agreements provide for cooperation in the protection of a wide range of environmental resources, ranging from water to air quality to wetlands and migratory bird habitat. With the recent adoption of NAFTA and its environmental side agreement, agencies and private groups on one side of the border now have the right to petition the legal institutions of the other nation to enforce its laws within the border region (NAFTA 1993).

Among the objectives established for the next five years in the U.S.-Mexico Border XXI Program are:

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- Enhance protection of natural resources and long-term sustainability of flora and fauna in the USPB. Complete a basic inventory of the flora and fauna and monitor water quality.
- Pending available resources, establish binational priorities and develop a long-term joint program to systematically map and characterize the Colorado, Santa Cruz, and San Pedro surface and groundwater basins.

Thus, the institutional framework is in place or being established to develop better information on water resources and ecological resources in the USPB. Further, "protection" of those resources has been mutually agreed to as a binational goal. NAFTA provides some leverage for organizations interested in assuring successful implementation of these stated objectives, as does the framework of binational and multilateral agreements relating to environmental protection. Whether these generally favorable institutional arrangements and commitments prevail in a political climate in Mexico characterized by pressure for rapid economic development will determine to a great extent the future health of the natural environment of the USPB.

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1 # 9.0 GLOSSARY

A-weighting scale	A scale designed to predict the response of the human ear to noise. It corrects for the inherent frequency response of the ear. This scale approximates the relative noisiness of different sounds and is the most commonly used measurement scale. Decibels on the A-weighted scale are abbreviated dBA.
above mean sea level (amsl)	Used for elevation.
air contaminant concentration	The amount of pollutant per unit volume of air. Air contaminant concentrations are expressed either in micrograms per cubic meter ($\mu g/m^3$) or parts per million by volume (ppm). A concentration in m3 is the weight in micrograms of the pollutant contained in each cubic meter of air. A concentration in ppm is the fraction in millionths of an air sample that consists of the pollutant.
air contaminant emission rate	The amount of contaminant released in a given amount of time. Release rates used in air pollution permitting are usually expressed in tons per year.
alternative energy sources	Sources of energy that are renewable or cannot be depleted, or that would otherwise be wasted but instead are recovered. Solar energy is the most common alternative source.
ambient air quality standards	Legally enforceable limits on the level of criteria pollutants in ambient air.
Antiquities Act	Law that prohibits the destruction of historic and prehistoric sites or artifacts on federal lands and requires protection and preservation as well as a permit to excavate archaeological sites. Allows the U.S. president to declare public lands as national monuments. (Enacted 1906)
aquifer	An underground rock layer of permeable material that can transmit and hold groundwater.
Archaeological and Historic Preservation Act (AHPA)	Law that declares all federal agencies managing construction programs are responsible for any damages to scientific, prehistoric, and historic resources and are authorized to fund recovery, protection, and preservation of significant archaeological data and materials. (Enacted 1974).
Archaeological Resource Protection Act (ARPA)	Law that strengthens preservation and protection laws through civil and criminal felony-level penalties for the destruction of resources and sites. (Enacted 1979).
Arizona Department of Environmental Quality (ADEQ)	A state of Arizona department responsible for administering programs pursuant to regulations promulgated by the Environmental Improvement Board.
Army Training Evaluation Program (ARTEP)	ARTEP "lanes" and training areas have been established on the East and West Ranges in order to restrict maneuvering activities to designated routes and to avoid environmentally sensitive areas. There are 9 ARTEP lanes on the West Ranges and 5 ARTEP lanes on the East Range. Cross country travel is restricted to the ARTEP lanes.
Asbestos Hazard Emergency Response Act of 1986	Federal law requiring local education administrators to identify asbestos hazards and develop abatement plans.
Army Stationing and Installation Plan (ASIP)	A Department of the Army - level document which gathers from all official sources within the DOD projections for the number of authorized positions for the following six years. It is used as a planning document for mission support. The ASIP does not predict the actual funding or guarantee that all positions will be funded in the out years.

attenuation of sound	Any noise level is diminished with distance from the source in a mathematically predictable manner. Under normal conditions, distance alone reduces the noise level by 6 dB for each doubling of the distance from the source. For example, a noise source that produces an 80-dB noise level at a distance of 50 m would produce 74 dB at 100 m. Absorption of sound energy by the atmosphere reduces noise levels even further.
baseflow	The portion of a stream's discharge that is maintained by groundwater seepage.
biological assessment	A study concerning listed and proposed species and their critical habitats and an evaluation of the potential effects of an action on these species and habitats.
biological hazard	Living organisms (or their products) that may cause disease or infection of exposed individuals. Includes plants, insects, animals, and indigenous pathogens or microorganisms.
CALINE3 Model	Developed by the California Department of Transportation and used to predict the effects of vehicles on air quality.
candidate species	Species for which the U.S. Fish and Wildlife Service (USFWS) has on file enough information on biological vulnerability and threat to support proposals to list them as endangered or threatened.
Clean Air Act	Law originally passed in 1970 to "protect and enhance the nation's air resources." Its primary application is through prevention of significant deterioration permits to regulate new potentially polluting facilities, although the NESHAPs are of increasing importance. Administered by EPA.
Clean Water Act	Law that amended the federal Water Pollution Control Act first passed in 1956. Its objective is to "restore and maintain the chemical, physical, and biological integrity of the nation's waters." The major enforcement tool is the NPDES permit. Administered by the EPA.
component plans	Fort Huachuca planning documents which are a subset of the Future Development Master Plan.
cone of depression	Region within an aquifer where the static water level or hydraulic pressure (head) has been diminished as a result of groundwater withdrawal.
criteria pollutants	Pollutants defined in the Clean Air Act: particulate matter, sulfur oxides, ozone, carbon monoxide, nitrogen dioxide, and lead.
day-night average sound level	The energy basis average sound level with a 10 dB penalty applied to sound that occurs between 10 PM and 7 AM for the purpose of allowing for the additional annoyance produced by sounds that occur during normal sleeping hours.
decibel (dB)	Unit of measurement used for sound levels. The dB is a logarithmic unit because the response of the human ear to varying levels of sound energy closely follows a logarithmic relationship. The perceived sound level (loudness) is directly related to the logarithm of the amount of energy carried by the wave. Each 10 dB increment represents a factor of 10 in energy. Thus, a sound wave of 80 dB intensity carries 10 times as much energy as a sound wave of 70 dB. Addition of sound levels must be done by converting decibels to an energy basis, adding, and then converting back to decibels. For example, 2 sounds of 80 dB produce an additive effect of 83 dB, not 160 dB.
Ejido	Peasant cooperative ownership protected by Mexican law
electric capacity	Total electrical power that can be delivered by a given generating plant, transmission line, or distribution system.
electricity demand	Amount of electrical power required for all equipment connected to the power source at a given time.

endangered	Those species in danger of becoming extinct throughout all or a portion of their range.
Endangered Species Act	An act of the U.S. Congress of 1972; 16 U.S.C. 1531-1543. The Act requires federal agencies to ensure that their actions do not jeopardize the existence of endangered or threatened species.
ephemeral stream	Stream that flows only in direct response to rainfall (or snowmelt) runoff and is dry at other times.
extirpation	Generally used in ecology to convey the destruction of a species in a defined area, as opposed to the extinction of a species throughout its range.
firebreak	Area cleared of vegetation to stop the spread of a wild fire.
floodplain	Low, flat ground along a stream which is subject to flooding and consists of sediments deposited by the stream.
Future Development Master Plan	Fort Huachuca's master plan, which examines and guides the Fort's landuse over the next 20 years.
generator	Owner or operator of an industrial or other facility producing regulated quantities of toxic or hazardous wastes.
GIS	Geographic Information Systems used to collect, store, manipulate, and analyze digital spatial data.
hazardous materials regulations	Regulations that govern the transportation of hazardous materials by air, highway, rail, water, and intermodal means; administered by various agencies of DOT.
hazardous waste	As defined in RCRA, a solid waste, or combination of solid wastes that because of its quantity; concentration; or physical, chemical, or infectious characteristics may cause or significantly contribute to an increase in mortality or an increase in serious, irreversible, or incapacitating illness or pose a substantial present or potential harm to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.
Historic Sites Act	Law that establishes policies for the preservation of historic resources of national significance, including historic buildings, sites, and objects. (Enacted 1935).
hydraulic conductivity	The rate at which water can move through porous material (e.g., soil, sedimentary rock) under certain conditions.
INPUFF Model	An air dispersion model used to estimate downwind concentrations of pollutants.
Installation Compatible Use Zone Survey	A survey to determine the suitability of various parts of an installation for specific types of applications and landuses based on noise levels.
intermittent stream	A stream that is perennial along some reaches but not along others.
ionizing radiation	Radiation capable of removing electrons from atoms it encounters. High doses of ionizing radiation may cause cell damage.
ITAM Program	U.S. Army Integrated Training Area Management program designed to integrate land management and army training mission requirements.
listed	Those species that have gone through a listing process and have received protection under the Endangered Species Act.
loosing stream	A stretch of a creek or river along which water migrates from the surface flow into the adjoining alluvial aquifer. The result is a decrease in the water volume in the streamflow.
material safety data sheet	Descriptive information on hazardous chemicals under Hazards Communication Standards.
mitigation	In an EIS, refers to activities that decrease negative environmental impacts.

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mobility fuels	Fuels used in vehicles and aircraft.
Modified Mercalli Scale (MMS)	A method of evaluating the intensity of an earthquake based on its impact on the people in the affected area. The scale ranges from I, which is imperceptible to people in the effected areas, to XII, which damages all buildings and destroys most.
monsoon	A seasonal large-scale weather pattern in which there is a reversal in the direction of wind and moisture circulation.
National Historic Preservation Act (NHPA)	Law that states that the federal government will cooperate with other governments (including state and local), Indian tribes, and private organizations and individuals to ensure that prehistoric and historic resources are properly preserved for present and future generations. (Enacted 1966).
National Register of Historic Places (NRHP)	Document containing those resources deemed to be important in American history, architecture, anthropology, engineering, or culture and associated with significant past events or persons and/or representing distinctive construction or high artistic value.
Native American Graves Protection and Repatriation Act (NAGPRA)	Law that states that any remains of American Indians (and associated objects) must be professionally curated and made available to any descendants for a traditional tribal burial. (Enacted 1990).
neotropical migrants	In this region of the U.S., refers to birds that nest in this country but also migrate south of the U.S.-Mexico border.
perched aquifer	A groundwater body retained above the regional water table by a localized layer of relatively impermeable geological material.
perennial stream	A stream that flows year-around due to contributions of both rainfall/snowmelt runoff and groundwater baseflow.
pictograph	Prehistoric drawing or painting on rock.
piedmont	A region of foothills or plateaus at the base of a mountain range, extending into the adjacent lowland.
PCB (Polychlorinated Biphenyl)	Pathogenic and teratogenic industrial compound used as a heat-transfer agent. PCBs may accumulate in human or animal tissue.
Quaternary	The most recent period of earth's geologic history, which includes the last 2 million years.
radiation hazards	Energy emitted by radioactive materials (alpha particles, beta particles and gamma rays) that may ionize molecules in living cells and upset normal cellular function causing cell dysfunction or death.
recharge	Percolation of rainwater and snowmelt through the soil unsaturated zone to the groundwater table.
regional aquifer	An hydraulically connected volume of groundwater, usually fed by a variety of recharge sources.
Resource Conservation and Recovery Act of 1976 (RCRA)	Law that established a variety of standards for generators, transporters, waste treatment, storage, and disposal facilities dealing with hazardous wastes, to control hazardous wastes from "cradle to grave." Substantially enhanced by the Hazardous and Solid Waste amendments of 1984. Administered by EPA.
restoration	Cleanup of sites contaminated with hazardous substances during past production or disposal activities.
Richter scale	Method of evaluating earthquake intensity as a function amount or amplitude of the seismic energy released during an episode.
riparian	Pertaining to a river-bank.
Safe Drinking Water Act	Law stating the maximum contaminant levels in groundwater. These levels are used

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	in groundwater monitoring programs.
satellite accumulation point	Area near the work place where hazardous waste is accumulated.
scoping	Process in the beginning stages of an EIS during which the public and federal and state agencies may voice concerns they wish the study to address.
SCREEN Model	EPA screening model used to estimate downwind concentrations of air contaminant releases.
solid waste	Garbage, refuse or sludge, including solid, liquid, semisolid or contained gases resulting from industrial, commercial, agricultural and mining operations, and community activities. Solid waste excludes material in domestic sewage, discharges subject to regulation as point sources under the federal Water Pollution Control Act, or any nuclear material or byproduct regulated under the Atomic Energy Act.
solvent	A liquid capable of dissolving, absorbing, and diluting 1 or more other substances.
State Historic Preservation Office (SHPO)	Office that works in coordination with other government agencies to ensure that steps are taken to maintain, preserve, or mitigate adverse impacts to historic features in the state.
stationary fuels	Fuels that are consumed by fixed facilities. Examples include heating fuels and industrial fuels.
storage coefficient	A value that indicates the fraction of a volume available for containing a fluid.
tectonic forces	The complex interaction between material in the earth's fluid interior and the overlying crust.
Tertiary	The period in geological history from about 2.5 million years ago to 65 million years ago.
threatened Species	Threatened species are those likely to become endangered in the foreseeable future.
tiering	Process of covering general materials in a broad-scoping document, with further narrow-scoping documents to cover more precise information through reference.
Toxic Substances Control Act	Law enacted in 1976 to protect human health and the environment from unreasonable risk due to exposure to, and manufacture, distribution, use or disposal of, toxic substances. Administered by EPA.
transmissivity	Rate of flow of ground water in units of volume per unit of time. It represents the amount of water that flows across a representative vertical surface of unit width through the entire thickness of the aquifer layer.
treatment, storage or disposal facility	Hazardous materials facility regulated under RCRA.
U.S. Department of Defense	Organization responsible for administering military programs to protect the nation from external aggression; manages arsenals and other facilities containing hazardous materials and wastes.
U.S. Department of Transportation	Enforces regulations governing the transport of hazardous and nonhazardous materials.
U.S. Federal Insecticide, Fungicide and Rodenticide Act of 1972 And 1988	Law mandating toxicity testing and registration of pesticides.
underground storage tank	Any tank or associated piping containing hazardous materials as defined by Subtitle C or D of the Hazardous and Solid Waste Amendments.
waste stream	Terminology used to refer to waste leaving a facility or operation.
water table	The upper limit of groundwater within an aquifer.

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watershed	Area of land draining into a stream at a given location. Also known as catchment or river basin.
xeriscaping	Water-conserving method of landscaping in arid and semiarid climates.

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LIST OF ACRONYMS AND ABBREVIATIONS

mg/m^3	micrograms per cubic meter
mm	micrometer (one-millionth of a meter)
AA	Airport Airspace
AAFES	Army Air Force Exchange Service
AATTC	Advanced Airlift Tactical Training Center
ac-ft	acre feet
ACHP	Advisory Council on Historic Preservation
ACOE	Army Communities of Excellence
ACTD	Advanced Concept Technology Demonstration
ADEQ	Arizona Department of Environmental Quality
ADES	Arizona Department of Economic Security
ADNL	average daily noise level
ADWR	Arizona Department of Water Resources
AEROSTAT	AEROSTAT Radar System
AFH	Army Family Housing
AGFD	Arizona Game and Fish Department
AHPA	Archaeological and Historic Preservation Act
AIB	Applied Instruction Building
AMA	Active Management Area
AR	Army Regulation
AR 210-20	Army Regulation 210-20
ARCOM	Army Reserve Command
ARS	Arizona Revised Statutes
ARTEP	Army Training Evaluation Program
ARPA	Archaeological Resource Protection Act
ARSC	U.S. Army Reserve Support Command
ASA	Army Security Agency
ASIP	Army Stationing and Installation Plan
ASL	above sea level
ASM	Arizona State Museum
ASP	Ammunition Supply Point
AT	Annual Training
AVGAS	aviation gasoline
AWC	Arizona Water Commission
AZ ANG	Arizona Air National Guard
AZ ARNG	Arizona Army National Guard
B&B	Bed and Breakfast
BEA	Bureau of Economic Analysis
BLM	U.S. Bureau of Land Management
BMP	Best Management Practice
Bn	Battalion
BRAC	Base Realignment and Closure
C&D	construction and demolition
CECOM	U.S. Army Communications Electronic Command
CEQ	Council on Environmental Quality
CERL	Construction Engineering Research Laboratory
CFR	Code of Federal Regulations
CIP	Capital Improvement Plan
CIS	Capital Investment Strategy
cfs	cubic feet per second
COE	U.S. Army Corps of Engineers
CPOC	Civilian Personnel Operations Center
CRMP	Cultural Resources Management Plan
dB	decibel(s)
DA	Department of the Army
DEH	Directorate of Engineering and Housing, Fort Huachuca
DES	Department of Economic Security
DIS	Directorate of Installation Support
DISA	Defense Information System Agency
DoD	U.S. Department of Defense
DPTM	Directorate of Plans, Training, and Mobilization
EA	Environmental Assessment
ECM	electronic counter measures
EIFS	Economic Impact Forecasting System
EIS	Environmental Impact Statement
ENRD	Environmental Natural Resource Directorate
EPA	U.S. Environmental Protection Agency
EPG	U.S. Army Electronic Proving Ground
ERMP	Energy Resources Management Plan
ESA	Endangered Species Act
EW	Electronic Warfare
FA	Family Unit
FAA	Federal Aviation Administration
FG	Fighter Group
FISTV	fire indirect support team vehicle
FLPMA	Federal Land Protection and Management Act
FOB	Forward Operating Base
FORSCOM	U.S. Army Forces Command
ft/d	feet per day
GIS	geographic information system
gpd	gallons per day
gppd	gallons per person per day
gpm	gallons per minute
GPS	Global Positioning System
GSA	General Services Administration
HFTF	High Frequency Test Facility
lbs/acre	pounds per acre
ICUZ	Installation Compatible Use Zone
IDG	Installation Design Guide
IDT	Inactive Duty Training
IEWTD	Intelligence Electronic Warfare Directorate
IFTX	Integrated Field Training Exercises
INRMP	Integrated Natural Resources Management Plan
ISCP	Installation Spill Contingency Plan
ISEC	U.S. Army Information Systems Engineering
ITAM	Integrated Training Area Management
J-STARS	Joint Surveillance Target Attack Radar System
JITC	Joint Interoperability Test Command
JOTS	Joint Operations Training Site
kW	kilowatt(s)
kWh	kilowatt hours
kVA	kilovolt amperes
LAAF	Libby Army Airfield
LCTA	Land Condition Trend Analysis
LN	Lane
LRAM	Land Rehabilitation and Maintenance
LRC	Long Range Component
MACOM	Major Army Command
MBTU	million British thermal unit(s)
MCA	Military Construction Army
MC	Mobilization Component
MG	million gallon
mgd	million gallons per day
MI	Military Intelligence
MILCON	military construction
MMS	Modified Mercalli Scale
M&S	modeling and simulation
MSL	mean sea level
MTMC	Military Traffic Management Command
MTMCTEA	Military Traffic Management Command Transportation Engineering Agency
MOGAS	mobility gasoline (ordinary unleaded gasoline)
MOU	Memorandum of Understanding
MSW	municipal solid wastes
NAAQS	National Ambient Air Quality Standards
NAF	Non-Appropriated Fund
NAFTA	North American Free Trade Agreement
NAGPRA	Native American Graves Protection and Repatriation Act
NCSHPO	National Council of Historic Preservation Officers
NEPA	National Environmental Protection Act

NHPA	National Historic Preservation Act
NO^2	nitrogen dioxide
NOA	Notice of Availability
NOI	Notice of Intent
NPDES	National Pollution Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
OMA	Operation and Maintenance Army
POM	Program Objective Memorandum
PCB	polychlorinated biphenol
ppm	parts per million
QSD	Quality Safe Distance
RCRA	Resource Conservation and Recovery Act
RDT&E	Research, Development, Test & Evaluation
ROD	Record of Decision
RPIP	Real Property Investment Plan
RPM	Real Property Maintenance
RPMP	Real Property Master Plan
RTV	Rational Threshold Value
RV	recreational vehicle
SCB	Soldier Community Building
SF	Square Feet
SHARC	Sierra Huachuca Association of Retarded Citizens
SHPO	State Historic Preservation Office
SOx	sulfur oxides
SPCCP	Spill Prevention, Control and Countermeasures Plan
SPRNCA	San Pedro Riparian Natural Conservation Area
SRC	Short Range Component
SWATS	Southwest Asian Training Site
T&E	Threatened and endangered
TAB	Tabulation of Existing and Required Facilities
TESS	threatened, endangered and sensitive species
TEXCOM	U.S. Army Test and Experimentation Command
TM	Technical Manual
TR	Transitional Residence
TRADOC	U.S. Army Training and Doctrine Command
TRI	Training Requirements Integration
TSP	total suspended particulates
UAV	Unmanned Aerial Vehicle
UAV-CR	Unmanned Aerial Vehicle-Close Range
UAV-MAE	Unmanned Aerial Vehicle-Medium Altitude Endurance
UAV-SR	Unmanned Aerial Vehicle-Short Range
USAEPG	U.S. Army Electronic Proving Ground
USASC	U.S. Army Signal Command
USAF	U.S. Air Force
USAG	U.S. Army Garrison
USAIC	U.S. Army Intelligence Center
USAIC&FH	U.S. Army Intelligence Center & Fort Huachuca
USC	United States Code
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	United States Geological Survey
USPB	Upper San Pedro Basin
UTES	Unit Training Equipment Site
UXO	unexploded ordnance
WETS	Weekend Training Site
WSCA	Wildlife of Special Concern in Arizona
WWTP	Wastewater Treatment Plants

APPENDIX A SUMMARY OF HYDROGEOLOGY

The purpose of this appendix is to provide the reader with additional information on the hydrogeological reports cited in the main body of the Fort Huachuca, Future Development Master Plan, Environmental Impact Statement. Some of these reports will be available to the public at the same location as the EIS, while others can be found at university libraries or requested from the relevant government agencies. All of these reports contain references to supporting studies, not summarized here, which may also be of interest to the reader. Although not an exhaustive review, the documents summarized here represent the principal body of knowledge on the hydrogeology of the Upper San Pedro River basin.

Because most of these studies are based upon the same data sources, there is a great deal of repetition both in the data presented and in the interpretation of the data. It should be recognized that much analysis and many conclusions have been drawn from a relatively small data set. Despite ongoing efforts to fill the gaps in the knowledge base, none of the studies available to-date fully describes or explains the complex hydrogeology of the Upper San Pedro River basin.

A.1 SUMMARY OF PUBLISHED LITERATURE

Numerous studies have been conducted to gain a better understanding of the hydrogeology of the Upper San Pedro River basin. Some of these studies involved actual field survey and data collection, some were modeling efforts, and others provided a review of existing information. All of these studies differ to some extent in purpose and scope but can be grouped into a number of overlapping categories: basic research, water supply, planning, and mitigation.

A.1.1 Hydrogeology Studies

Basic research has been performed by the U.S. Geological Survey (USGS), including field surveys by Roeske and Werrell (1973), Brown and others (1966), the modeling effort of Freethey (1982), and geomorphic research by Hereford (1993). In addition, published and unpublished USGS streamflow and groundwater data have commonly been used or referenced in other studies. Similarly, the Arizona Department of Water Resources (ADWR) has been a source of basic hydrographic and well water-level data (ADWR 1991).

Several hydrogeologic investigations were commissioned specifically for the purpose of identifying and quantifying the groundwater resources available for Fort Huachuca water supply. These include studies by the USGS (Brown et al. 1966) and the U.S. Army Corps of Engineers (COE) (COE 1974b; Harshbarger and Associates 1974; COE 1987). State agencies have also been asked to evaluate the water situation of the Fort and to assess the effect of civilian groundwater pumping on the Fort's water rights (AWC 1974; ADWR 1991).

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State, federal, and local entities have conducted studies for water planning and management purposes. The ADWR examined the water resources of the Upper San Pedro River basin when considering it for designation as an Active Management Area (ADWR 1988) and produced a comprehensive hydrographic survey report for the basin as part of the Gila River adjudication process (ADWR 1991). To aid in the adjudication, the federal government initiated the develop-ment of a hydrologic model of the San Pedro River system on behalf of the Gila River Indian Community (W&EST 1993). Another federal agency, the Bureau of Land Management, examined the hydrogeology of the basin when planning the San Pedro Riparian National Conservation Area. Local groups have commissioned historical and scientific reviews to aid the public in understanding the water situation (ASL 1994; Geraghty and Miller 1995). Additional research in river basin planning and management has been conducted by students and faculty of the University of Arizona (Schwartzman 1990; WWRC 1991; Vionnet and Maddock 1992; Sharma et al. 1997).

The Army and civilian agencies have long recognized that the negative effect of groundwater overdraft would have to be mitigated in order to sustain the ground water supply and protect instream flows. The City of Sierra Vista commissioned research on the feasibility of recharging the regional aquifer with stormflow or treated effluent (SLA 1988; ASL 1995; BOR 1995). The Army has also explored the possibility of mitigating groundwater overdraft by implementing additional water conservation measures and by inducing artificial recharge of mountain stormflows and effluent (USAG 1995a; USAG 1995b; SAIC 1997).

A.1.2 Computer Models

Several of the studies summarized in this appendix employed computer models to simulate the hydrogeology of the San Pedro River basin or portions of the basin. These models were typically used to determine pre-development conditions within the basin, estimate current conditions where no data are present, and predict the future effect of various water management scenarios on the hydrogeologic system. Such models are well-established tools of the hydrologist and hydrogeologist. However, the validity of model results is highly dependent upon the accuracy and adequacy of the conceptualizations of the hydrogeologic system and groundwater-surface water interactions, quality and sufficiency of the input data, parameter estimates, mathematical formulation, grid geometry, model calibration and model assumptions. If the input data are inadequate or the model assumptions incorrect, information generated by a model will be invalid or misleading. This is a particular concern in the San Pedro River basin where lack of information on the complex basin geology, hydrogeology, water table elevations, recharge and discharge, seasonal and long-term streamflow variability, baseflow and flood runoff contributions to river flow, and changes in climate, riparian vegetation and evapotranspiration complicate the modeling process.

Published results of modeling efforts made to-date should be considered preliminary. Several investigators are actively working to improve their basin models and to incorporate the latest hydrogeological data being collected by federal and state agencies. It is expected that newer models will more accurately reflect the

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hydrogeological conditions and processes in the San Pedro River basin, and will be thoroughly validated before the results are used for making water policy or management decisions.

A.2 BASIC RESEARCH, WATER SUPPLY, AND PLANNING STUDIES

The studies cited above are summarized in 2 subsections. This subsection lumps together basic research, water supply, and planning studies, and the subsequent subsection covers studies related to existing and potential mitigation measures. The reports are discussed in chronological order within each subsection. Conclusions taken directly from the original report (i.e., quoted) are shown as indented text.

A.2.1 USGS Water Supply Study of Fort Huachuca (Brown and Others 1966)

From 1959 to 1963 the U.S. Geological Survey conducted a comprehensive investigation of water resources of the Fort Huachuca Military Reservation and pertinent adjacent areas. The purpose of the investigation was to locate additional water supplies for the Fort and to appraise the water resources in use. The subsequent report described the geology, hydrology, and availability of water in the area, and included analyses of well-field characteristics and water quality.

During the period of study, the investigators found that water levels in an observation well declined more than 7 ft, indicating that the cone of depression formed by pumping the wells at Fort Huachuca and Sierra Vista was deepening and expanding. They concluded that the aquifers tapped by the Fort and Sierra Vista (and adjacent housing developments) were hydraulically connected and that continued pumping of the wells in the Sierra Vista area would in time cause a drawdown of the water table in the Fort's well field. The investigators suggested that spring flow from the mountain canyons could be used to decrease the draft on the groundwater reservoir, or used for artificial recharge of the aquifers. They also suggested that a second well field could be developed to reduce the draft on the established well field, and to utilize groundwater that now moves unused northeastward to the San Pedro River.

A.2.2 USGS Report on The Hydrologic Conditions in the San Pedro Valley (Roeske and Werrell 1973)

This USGS report was prepared for the Arizona Water Commission and presented fundamental data on the hydrology, hydrogeology, and water resources of the San Pedro Valley. The investigation included measurement of well water-levels (in about 350 wells), stream and spring dis-charges, and groundwater pumpage; assessment of irrigated acreage; evaluation of driller's logs; and analysis of groundwater chemistry. From the results of their analyses, the investigators were able to estimate the water-yielding characteristics of the basin aquifers. Some of these data were later used as input to various computer models developed by other researchers. Among their findings, the USGS investigators stated that:

The amount of ground-water withdrawal is in excess of the amount of recharge in the Sierra Vista-Fort Huachuca area; a cone of depression has developed in the area, and near the center of the cone, water levels have declined about 30 ft in 25 years. As withdrawal continues in excess of recharge, the cone of depression will expand and deepen. From 1965 to 1969, the water level in well (D-21-21)27abd about 6 miles east of Sierra Vista declined 9 ft owing to the expansion of the cone of depression.

A.2.3 U.S. Army Corps of Engineers Water Supply Report for Fort Huachuca (COE 1974a)

The Army has long been concerned about protecting and enhancing the water supply for Fort Huachuca. The purpose of this report was to evaluate the water supply needs for the Fort and surrounding communities under various population projections; to assess the groundwater resources of the Upper San Pedro River basin; to present results of the East Range drilling program; to analyze the results of Arizona Water Commission groundwater modeling; and to propose concept designs and cost estimates for expanding the Fort's water supply system.

The report included the findings of four inter-related studies which were attached as appendices: (1) Report on Water Development in the Ft. Huachuca Area, Arizona (Harshbarger and Associates 1974), (2) Status Report of a Study of the Adequacy of the Water Supply of the Fort Huachuca Area, Arizona (AWC 1974), (3) Investigation and Recommendations for Upgrading the Water System at Fort Huachuca, Arizona (Blanton & Co. 1973), Concept Design Report for Proposed Water System Expansion, Fort Huachuca, Arizona (Blanton & Co. 1974), and (4) Fort Huachuca, Arizona, Supplemental Report: Test Well Drilling and Study of Hydrogeologic Conditions (COE 1974b). The Harshbarger and AWC reports are summarized below.

A.2.4 Report on Water Development in the Fort Huachuca Area (Harshbarger and Associates 1974)

The purpose of this consultant's report, prepared for the COE, was to review existing hydrogeo-logical data on Fort Huachuca and the Upper San Pedro basin and to provide the COE with an independent opinion as to the availability of groundwater supplies and the effect of groundwater development on the hydrogeological system. No field work was con-ducted by the contractor; the analysis was based solely on data provided by the COE, Arizona Water Commission, and other published reports.

- Adequate volumes of recoverable groundwater are present in the regional aquifer to satisfy the maximum projected demand. It is conservatively estimated that the volume of recoverable groundwater in storage in the regional aquifer is 8 to 15 times greater than the total projected water demand.
- Projected water requirements for a military population of 50,000 could be satisfied by construction of the proposed well field on the East Range. Drawdown in the proposed well field after 80 years of pumping would be on the order of 60 to 100 ft.
- Future interference effects with civilian groundwater users in the area are of acceptable magnitude with a proper management plan. The depression cone developed by the proposed East Range well field would not cause significant infiltration of water in the channel of the San Pedro River.

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- Future refinement of the digital model will improve the agreement between simulated and measured water levels in some areas. The magnitude of predicted drawdown in the regional aquifer will not be significantly affected by these future model refinements.

A.2.5 AWC Report on the Adequacy of Water Supply in Fort Huachuca Area (AWC 1974)

The Arizona Water Commission (AWC) began a study of groundwater resources of the Upper San Pedro River basin in 1972 and was subsequently asked by the COE to prepare a special report evaluating the adequacy of Fort Huachuca's water supply. The AWC investigators used a computer model (referred to only as a modification of [a model] in use by the USGS) to simulate the basin groundwater system and to evaluate the long-term effects of pumping under a variety of conditions and demands. The AWC reported the following conclusions:

- The digital model of the groundwater reservoir in the Fort Huachuca area has, primarily due to time constraints, not yet been verified to the degree that permits unequivocal reliance. Nevertheless, it is concluded that the model as presently developed is able to give a reasonable prediction of the range of possible effects on the future demands for water on the groundwater resource.
- On the basis of the studies to date, it is evident that the effects of the projected groundwater demands for all demand levels considered have a large impact on the groundwater reserves.
- The studies to date also indicate the impacts of the large withdrawals for Alternative population levels III and IV from the Fort's present well field on the water resources are unacceptably severe as the aquifer underlying this well field as well as that under the adjacent portion of Sierra Vista probably would be dewatered by 2060. However, the impact in this area can be relieved through a water management option that would place a greater share of the demand on the proposed East Range well field where greater groundwater supplies are available.
- Based on studies by the Bureau of Reclamation the [AWC] concludes that the authorized Charleston Dam project could supply sufficient water to meet all the projected water demands in the Fort Huachuca area.
- It is preliminarily concluded that effects of the projected groundwater pumpage for all population levels would reduce the base flows as well as possibly reduce the water supply available to phreatophytic vegetation along portions of the San Pedro and Babocomari Rivers.

A.2.6 USGS Hydrologic Analysis of the Upper San Pedro Basin (Freethey 1982)

The purpose of this U.S. Geological Survey investigation was to develop a numerical groundwater model of alluvial basins in the Southwest. Existing information for the Upper San Pedro River basin, considered to be representative of such basins, was used to develop and test the model. The investigator determined that the three-dimensional model adequately simulated groundwater flow, the stream-aquifer connection, and evapotranspiration, but warned against using the model to simulate and analyze site-specific problems or to evaluate water-level changes throughout the model area. Water-level contour maps derived from existing data and data generated by transient simulations showed similar patterns of water level decline in the Fort Huachuca-Sierra Vista area and the expansion of the cone of depression. Freethey put the following caveat on the application of his model.

The numerical model developed during this study was designed and calibrated only to a degree necessary to attain a reasonable definition of the hydrologic system and to support, if possible, prior conceptions of how these hydrologic mechanisms work and interact. This model is one viable representation of the system. It should not be regarded as an exact, unique duplication of the hydrologic processes taking place. The model can be used to gain a better understanding of the interrelations that may occur when significant natural or manmade phenomena change one or more hydrologic processes. The model provides a starting point for the development of more detailed models when additional data become available. Water-level monitoring and streamflow measurements need to be continued and expanded as development in this area progresses.

A.2.7 U.S. Army Corps of Engineers Groundwater Modeling Study for Fort Huachuca (COE 1987)

Previous studies indicated that groundwater pumping by communities near Fort Huachuca would lower the local water table and threaten the Fort's water supply. Consequently, the COE undertook a study to quantify the groundwater parameters of the basin, evaluate future water use scenarios, and propose rehabilitative measures to be further investigated. A USGS regional groundwater model was used to evaluate existing groundwater conditions and predict the basin response to future water use scenarios. The COE used existing data as input to the model; initial values for aquifer parameters were those of Freethey (1982). Although the investigators felt that their model adequately simulated the hydrology of the upper San Pedro basin, they stressed that the reliability of model results was dependent on the reliability of the available recharge and discharge data, aquifer parameters, and historical water level estimates. Some of their findings:

Heavy pumping in the Fort Huachuca-Sierra Vista and Huachuca City areas has created cones of depression in the ground water table. The zone of influence around the Fort measures about 4 miles by 1-1/2 miles wide and is following new commercial development as it moves eastward. The cone in the Huachuca City area is about 3 miles by 1 mile wide and in this zone, the ground-water flow along the Babocomari River has reversed direction for some distance downstream. Ground water that previously flowed eastward, is now attracted to the pumping center.

It is evident that even at the current rate of pumping, the Fort Huachuca water supply may be threatened at some time in the not too distant future. Proposed growth of Sierra Vista would speed up the process of declining water levels, and one or more of the Fort wells may dry out within 45 years. Though the decline in the regional aquifer may be relatively small (i.e., less than 1 foot per year), it is nonetheless evident that overall ground water withdrawals are exceeding the safe yield. Several areas where intensive pumping is occurring will experience noticeable declines in the water table. As stated in many of the previous studies of the water supply for the basin, there is a vast supply of water within the basin aquifers. The problem concerns the possibility of existing wells drying out from the declining water levels.

It is becoming increasingly evident that definition of the aquifer's properties (i.e., the storage coefficient and the transmissivity) is very important in the modeling of the ground water system. Borehole and geophysical investigations would allow a clearer understanding of the anticipated drawdown of the water table. Wherever possible, pumping tests should be performed to supplement this analysis. Furthermore, the basin geology should be mapped in detail. This would help locate the boreholes, observation wells, and geophysical investigations. This report is limited by the available data for which a number of assumptions have been made and a complete definition of the substrata would help refine the model results.

As a result of their modeling efforts, the COE investigators concluded that, despite the vast amount of groundwater stored in the regional aquifer, present and future withdrawals far exceed the perennial (safe) yield of the basin, thus threatening not only the Fort's water rights but the water supply of the entire basin. They recommended that the Army use wells on the East Range in order to reduce the stress on the established well field. They also recommended that ground-water levels at the Fort be closely monitored and studies conducted to better define model parameters.

A.2.8 ADWR Study of Water Resources of the Upper San Pedro (ADWR 1988)

The Arizona Department of Water Resources (ADWR) examined the hydrology and water use of the Upper San Pedro (USP) basin in order to assess the merits of designating the basin as an Active Management Area. The report summarized and interpreted data from previous hydrological studies of the basin (including those described above) and incorporated more-recent ADWR data. The ADWR investigators also employed a regional groundwater model, and Freethey's (1982) data, to update and project future hydrologic conditions in the Sierra Vista area.

Among the findings, the ADWR determined that water levels have declined in the USP regional aquifer an average of less than one foot per year outside the vicinity of Sierra Vista and Fort Huachuca; even in areas of little or no groundwater pumping. Although the reason for this was unclear, they speculated that the decline was due to a regional adjustment brought on by down cutting of the San Pedro River. Since the down cutting occurred prior to extensive groundwater pumping in the region, they postulated that the change resulted from overgrazing or climatic variation. The ADWR investigators also determined that, based on flow duration curves, the flow regime of the San Pedro River at Charleston was unchanged over the last 50 years. The ADWR reported the following conclusion to their study:

1) Groundwater withdrawals in the regional aquifer around Sierra Vista resulted in an average groundwater decline rate of 1.4 feet per year between approximately 1968 and 1986. De-cline rates rose to a maximum of 3.7 to 3.9 feet per year for several wells however. A cone of depression of about 7.5 square miles, within the enclosed 4,150-foot water elevation contour, probably occurs in the vicinity of Sierra Vista. This cone has grown from an area of about 5 square miles in 1968. The time at which the cone originally developed is not known.

2) Continued groundwater pumpage between 1986 and the year 2000 will mine an additional 208,000 acre-feet of groundwater from the regional aquifer around the Sierra Vista area, resulting in a maximum groundwater decline of about 80 feet at a maximum rate of about 6 feet per year.

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3) Pumpage in the USP basin has not yet affected that portion of the regional aquifer adjacent to the San Pedro River except near Hereford. This conclusion is based on 1986 ground-water levels as estimated by an updated groundwater model of the area, and comparison of these water levels with 1968, 1978, and 1986 water level maps presented in this report. No significant change in groundwater levels has occurred near the San Pedro River at Lewis Springs or Charleston.

4) The groundwater model used to project water levels in the year 2000 showed that water levels in the regional aquifer several miles west of the San Pedro River would rise up to 20 feet at Hereford, would decline by about 10 feet west of Lewis Springs, and would decline by about 10 feet west of Charleston. This decline rate is about 0.7 feet per year. This model projection was based on estimated future pumpage.

5) The artesian heads present in some portions of the regional aquifer underlying the floodplain alluvium of the San Pedro River have decreased somewhat over time due to groundwater development in these areas.

6) The shallow floodplain aquifer which underlies the San Pedro River shows no long term declines in water level.

7) The retirement of agricultural lands acquired by the Bureau of Land Management will affect low flows in the San Pedro River, particularly in the Hereford area. The flow in the river will increase due to cessation of agricultural pumping, which will no longer draw water from the floodplain alluvium and San Pedro River. This will allow water levels in both the confined and unconfined regional aquifer to rise, enhancing groundwater discharge rates to the floodplain alluvium and river and increasing flow rates in the river. The increase in flow may eventually be offset somewhat if phreatophytes are allowed to invade previously fallow land.

8) No land subsidence has occurred in the USP basin to date.

9) There are no known regional water quality problems in the USP basin.

A.2.9 San Pedro River Riparian Management Plan and EIS (BLM 1989)

The Bureau of Land Management (BLM) prepared a combined master plan-environmental impact statement for the proposed San Pedro Riparian Natural Conservation Area (SPRNCA). An analysis of the surface water and groundwater resources within the SPRNCA and adjacent lands was presented in Appendix 5 of the document. Although the BLM recognized the San Pedro River as an important and unique perennial desert stream, the agency was also aware that the river system is degraded both in terms of historic hydrologic condition and habitat diversity.

After reviewing the literature and conducting field surveys, the BLM scientists concluded that the San Pedro River has, and is continuing, to undergo an evolution to a new dynamic equilibrium condition that reflects current hydrologic and land use conditions. They were uncertain as to the cause of observed reductions in stream base flow but speculated that it could be caused by:

- reduced recharge of the floodplain aquifer by the regional aquifer;
- reduced recharge of the floodplain aquifer by surface runoff (high flows);
- increased use of the floodplain aquifer through pumping;
- increased use of the floodplain aquifer by phreatophytes; or
- increased loss of floodplain aquifer water to the regional aquifer.

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The BLM team went on to state: It does not appear that the declines in base flows can be attributed to declines in overall runoff in the basin. Also, it is unlikely that changes in phreatophyte use or losses to the regional aquifer have significantly affected base flows. Thus, it can be deduced that either groundwater pumping in the floodplain aquifer, reduced recharge from the regional aquifer, or a combination of both have contributed to the lower base flows recorded at both [Charleston and Palominas] gauges.

A.2.10 Hydrological Resource Assessment of Lower Babocomari Watershed (Schwartzman 1990)

The Babocomari River is a principal tributary to the San Pedro River and flows near to the northern boundary of the Fort Huachuca military reservation. Schwartzman (1990) conducted an investigation of the lower Babocomari watershed in order to evaluate the effects of groundwater pumping on the river. The author summarized existing geological and hydrological information for the study area and monitored water level changes in local wells.

Schwartzman found that pumpage had affected flow patterns in the vicinity of northern Huachuca City and the Fort Huachuca East Range and that a minor cone of depression had formed in the area. Historic water-level declines in the study area had been low to moderate (4-12 inches). He concluded that continued groundwater level declines caused by pumping by local municipalities and Fort Huachuca would adversely affect the riparian habitat along the Babocomari River. The author recommended that water levels near the river be closely monitored in order to better manage the riparian resource.

A.2.11 ADWR Hydrographic Survey Report for the San Pedro River Watershed (ADWR 1991)

The Arizona Department of Water Resources (ADWR) prepared this Hydrographic Survey Report (HSR) as part of the General Adjudication of the Gila River System and Source. The document serves as a compendium of ADWR information concerning the San Pedro River and has been used as a source of data in subsequent analyses and modeling studies. Volume 1 of the report, General Assessment, described the nature of the adjudication proceeding, water supply and water uses, investigation methods used by ADWR, and the results of the investigations for major water users and non-Indian federal law claims. A very useful summary of the water resources of Fort Huachuca was provided in Volume 1, Chapter 5, pages 382-430 and a description of the modeling methodology used to determine pumping effects was given in Volume 1, Appendix G. Volumes 2 through 9 presented additional information on individual water users and uses, well reports, well lists, and maps.

In Chapter 4 of Volume 1 (Hydrologic Analysis), the ADWR researchers listed several conclusions about the hydrology of the San Pedro River. Conclusions relevant to the Sierra Vista-Fort Huachuca situation are given below (with the original item numbers used in the HSR).

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6) Cultural depletions impact the hydrologic system by lowering groundwater levels in the regional and floodplain aquifers and/or by directly reducing streamflow in the channels. The removal of groundwater may directly or indirectly interfere with streamflow. Direct interference occurs when the cone of depression of a pumped well(s) intercepts the streambed and induces surface water to move away from the stream. Indirect interference occurs when the cone of depression does not intercept the stream, but reduces the amount of groundwater discharged to the stream by intercepting groundwater flows.

8) The impacts of some cultural or groundwater withdrawals have not yet affected or reduced the surface water supply in the inner valleys, but are impacts in transit toward the younger alluvium that will eventually reach the younger alluvium. As more of these impacts arrive at the younger alluvium, their cumulative effect can be expected to further reduce the surface water supply.

24) A negative change in storage of -11,230 acre-feet is occurring in the Sierra Vista sub-watershed as a result of municipal groundwater pumping in the Sierra Vista-Fort Huachuca area and pumpage to supply irrigation uses located near the San Pedro River.

As in previous studies, the ADWR researchers found a direct correlation between population growth and water usage as seen by the declining groundwater levels in the Sierra Vista area. They stated that the cone of depression that has formed under Fort Huachuca and Sierra Vista may cause a problem with the Fort's water supply. The expansion and deepening of the cone would result in greater pump lifts and increased energy costs. In order to quantify the amount of diminishment of the water supply to Fort Huachuca, the ADWR investigators used the USGS MODFLOW model (Freethey 1982) to predict the effects of groundwater pumping by the Fort and surrounding communities. Two modeling scenarios were compared: the effect of past and future groundwater pumpage by the Fort alone on the water table, and, the combined effect of pumpage by the Fort and the surrounding municipal water companies on the water table. From this analysis the ADWR concluded:

The results of the model runs demonstrate that the additional drawdown to Fort Huachuca's wells because of the additional pumpage from the 8 surrounding water companies from 1940 through 1988 ranges from 13 feet at Fort Huachuca well No. 8 in the East Range, which is furthest from the pumping center, to 41 feet at wells No.1 and No. 2 nearest to the pumping center. The projected cost to the Fort over the 48 year period (1940-1988) could be between $75,000 to $125,000.

A pumpage scenario based on projected increases in population from 1989 through 2038 resulted in additional drawdown of 72 feet at well No. 8 to 223 feet at well No. 1 and No. 2. The projected cost from 1989-2038 could be between $500,000 and $1,880,000 over the next 50 years. [The ADWR stresses that this represents only a sample scenario; actual future growth rates and pumpage rates may be different.]

Fort Huachuca's response to a lowering of water levels might also result in more pumpage being shifted away from the pumping center to the East Range well [COE 1987]. This would result in fewer well deepening costs, repair costs, and a reduction in lift costs.

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A.2.12 Water Resources and Management Options for the San Pedro Basin (WWRC 1991)

In 1990, a student-faculty team from the University of Arizona responded to a request by Upper San Pedro Basin Water Resources Council to examine the water resources situation of the basin and evaluate various management options. The university team developed or adapted 4 models to analyze the situation: a regional groundwater model (MODFLOW), a surface water-groundwater model used to evaluate institutional water use options (MODSIM), a spreadsheet-based, hydrology-economics-water resource allocation model called WATERBUD, and a plan evaluation model known as MATS. The investigators emphasized that the results of their modeling efforts were based upon a 20-year period of analysis during which time the long-term implications of increased pumping from the regional aquifer were not readily apparent.

From the analyses performed with the 4 analytical models the investigators concluded the following:

1) Pumping from the regional aquifer in the Sierra Vista area is depleting stored groundwater reserves there, and accelerated pumping in the future will accentuate this trend unless steps are taken to arrest.
2) Pumping from the regional aquifer is not the major factor imperiling streamflow in the San Pedro River. Drought-related reductions in surface runoff and irrigation-related pumping from the floodplain aquifer are much stronger influences, particularly in the short term. Management of minimum streamflows and maintenance of riparian ecosystems will require control of agricultural pumping and, possibly, the imposition of drought-coping policies.
3) Potential conflict over water management policies in the Upper San Pedro basin will be rooted in differing value judgments concerning economic and environmental impacts. However, the common desire to maintain local control over water management decisions provides a basis for successful negotiation and policy development.

The university team also made several recommendations for future policy development, including several that have a direct bearing on water policy for Fort Huachuca and surrounding communities. The team recommended that the problem of groundwater overdraft be recognized and dealt with now rather than waiting for a future crisis. They also urged water conservation be encouraged through educational programs, replacement of water-wasting plumbing with water-saving plumbing, and reuse of effluent, either for irrigation or aquifer recharge.

A.2.13 Modeling of Groundwater Flow and Surface/ Groundwater Interaction for the San Pedro River Basin (Vionnet and Maddock 1992)

The purpose of this study, conducted by university investigators and funded in part by the Cochise County Flood Control District, was to improve an existing ADWR groundwater model of the Upper San Pedro River basin by making the following modifications: 1) augmentation of the original MODFLOW module data set with newly acquired information, 2) replacement of river module with new stream-aquifer model, 3) addition of layer to represent bank storage, and 4) recalibration of model using river baseflow data. The model grid was based on that developed by Freethey (1982). A steady state simulation was used to reproduce the mean annual conditions existing in 1940. Information from the steady state simulation was used in the transient simulation which represented the period 1940 to 1988. General conclusions of investigators are given below.

The match between simulated water level contour maps and field data water level contour maps was acceptable. However, a less acceptable match between MODFLOW simulated streamflows and estimated baseflows from field data was obtained...The runoff component of the streamflows was not taken into account during the simulations. It is generally argued that, within the study area, runoff is exceedingly rapid, allowing little infiltration to the ground-water system. However, the runoff volumes provided some surface storage, a small quantity of local storage to the alluvial aquifer, that is usually consumed by riparian vegetation.

Prior to major development, losses to evapotranspiration and to streamflow constitute the majority of the discharge from the system for both cases. The ground-water outflow at Fairbank constituted 3.5 percent of the total discharge, a small amount compared to the other 2 components.

By the end of the transient simulation period (1988), 13,680 acre-feet/year of water were being extracted through pumping. However, the peak pumpage of 17,190 acre-feet/year (23.7 cfs) was reached during the early 1980's.

Over the 48-year simulation period, the evapotranspiration losses reduced around 20 percent with respect to predevelopment conditions. Streamflow gains were also reduced drastically over the 48 years. These reductions were due to the ground-water withdrawals to pumpage. Model results indicate that 48 percent of the pumpage was derived from aquifer storage...

Model results are dependent on the distribution of pumpage in time and space. The pumpage used to simulate transient conditions were provided by ADWR. Municipal pumping has been revised by the ADWR. The ADWR is presently revising pumping figures for agriculture. This process will redefine pumping rates estimates for irrigation wells drilled mainly in the alluvial aquifer. Depending on the scope of this redefinition, model results and conclusions could be affected to different degrees, particularly if the revised wells are located near the river system.

Before any attempt to use this groundwater model, it is essential that the user be aware of the model capabilities and limitations. Conclusions extracted from future simulations with this model will have to be based on the model assumptions and limitations. With these caveats in mind, 2 principal conclusions may be drawn.

1) The geologic formation in the vicinity of Charleston initially inhibits the effects of the Sierra Vista cone of depression on the San Pedro River. Simulation indicates that the cone will spread southward to perhaps intersect the river upstream of the formation.

2) Although a better calibration of baseflows can be achieved by reducing the maximum evapotranspiration rate to partially compensate the absence of runoff volumes, alternative ways to incorporate those volumes should be attempted in the future.

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The investigators recommended that a Geographic Information System (GIS) be incorporated into the modeling process; the model grid be extended further east, north, and into Mexico; better field data be collected; water consumption by riparian vegetation be refined; the model time increment should be monthly instead of annual to accommodate seasonal variability; and recharge sources should be more accurately represented in the model.

A.2.14 San Pedro Hydrologic System Model, Preliminary Results (W&EST 1993)

In 1987, the consulting firm, Water & Environmental Systems Technology (W&EST), Inc., began development of a hydrological model of the San Pedro River. The work was done on behalf of the Gila River Indian Community, to assist the tribe in assessing its rights to waters of the San Pedro River, a tributary to the Gila River. The purpose of the model (actually, 2 related model codes: the USGS MODFLOW model and the proprietary WESTSP model) was to simulate pre-development basin hydrology and to predict the future responses of the system to cumulative stresses (e.g., groundwater pumping). The model was also designed to assess the incremental impacts imposed by one or more water users, such as the effect of groundwater pumping around Sierra Vista. Spatial data were assembled, manipulated, and mapped with the help of a GIS.

In their report, W&EST investigators detailed their initial efforts to assemble required input data, calibrate and verify their model, and perform preliminary analyses. Various modeling scenarios were tested to determine the effect of current and predicted pumping stresses on the groundwater and surface water system. Preliminary results indicated that the existing drawdown cone had not yet reached the San Pedro River, but that future pumping in the Sierra Vista-Fort Huachuca area, especially at increased rates, would result in the drawdown cone eventually reaching the river. The investigators concluded their report by recommending refinements that must be made to the model before results could be finalized.

A.2.15 Entrenchment and Widening of the Upper San Pedro River (Hereford 1993)

This USGS- and BLM-funded study provided a comprehensive and detailed analysis of the geo-morphic history and condition of the San Pedro River basin. The investigation included examina-tion of pre- and post-entrenchment alluvium, riparian vegetation changes, channel morphology, and the association of climatic history with channel widening. A summary of the findings showed that:

- The river flowed in a shallow, narrow channel on the surface of the unentrenched valley before 1890. A series of large floods, perhaps beginning as early as 1881, eventually led to entrench-ment of the channel between 1890 and 1908. This deepening placed the channel 1 to 10 m below the former floodplain. The channel has widened substantially since entrenchment through lateral migration and expansion of entrenched meanders. The rate of channel expansion, however, has decreased since about 1955, coincident with a decrease of peak-flood discharge suggesting that the channel has stabilized and that further widening will probably be minor under present conditions of land use, discharge, and climate.
- The reduction in peak-flow rates was related partly to increased channel sinuosity and to development of floodplains and riparian woodlands. The increased sinuosity produced a reservoir

effect that attenuated flood waves, and the development of floodplains enabled flood waters to spread laterally, thereby increasing transmission losses. In addition, flow rates were probably affected by improved land use and changes of rainfall intensity and short-term rainfall patterns, which reduced runoff and decreased the time necessary for channel stabilization. Livestock grazing decreased steadily after the turn of the century, and numerous stock ponds and small water-retention structures were constructed in tributaries. The cumulative effect of these structures probably reduced peak-flow rates. Short-term rainfall patterns of the wet season (June 15-October 15) have probably changed from annual alteration of above- and below-average rainfall to a biennial or longer pattern. Moreover, frequency of low-intensity rainfall (daily rainfall less than about 1.27 cm) was consistently above average for the decade 1957-1967. These factors probably improved conditions for growth and establishment of vegetation both in and outside the channel.

- The causes of the large floods that resulted in entrenchment are poorly understood, although climate and land use were key factors. Floods followed closely the rapid settlement of the area brought about by mining activity in the late 1870s; population rose from a few hundred to 6,000 in less than 5 yr. Extensive wood cutting for mine timber and fuel, suppression of wildfire, and reintroduction of large cattle herds undoubtedly exacerbated entrenchment. Flood-producing wet-season rainfall in the Southwest, however, was unusually heavy before, during, and shortly after entrenchment.
- The investigator also made some observations regarding the implication of these results to channel and floodplain management of the San Pedro River:
- Future development of the San Pedro River channel is a highly speculative topic; a number of geomorphic uncertainties permit only broad generalizations to be made. Nonetheless, manage-ment of the resources requires general predictions regarding the stability of the channel system. Evidence indicates that the channel has or is close to a stable configuration. This new equilibrium was reached after at least 55 years of adjustment through widening. The implication for channel and floodplain management is that the system has largely adjusted to the post entrenchment conditions. Therefore, the system will probably not change significantly, if these conditions remain within existing limits.
- Impounding of sediment in reservoirs and upstream withdrawals of surface water for agriculture, mining, or domestic use will compromise the present flow regimen, degrading the recently developed riparian community. This community is closely linked with groundwater level; a drop in this level would probably have the same effect on the riparian community as upstream impoundments and withdrawals. The effect of lowering the water table is well illustrated by the extensive degradation of the riparian environment following the entrenchment of the San Pedro River channel between 1890 and 1908. In short, extensive development and exploitation of groundwater resources will almost surely lower the water table, with predictable consequences for the riparian forest.

A.2.16 Sierra Vista Subwatershed Primer (ASL 1994)

This document was produced for the City of Sierra Vista and 2 local water companies to provide the public with an easy-to-understand summary of the current water situation in the Sierra Vista area. The authors reviewed the existing technical literature and made additional interpretations of the information. Extracts of their conclusions are given below.

1) The water resources issues facing the residents of the Sierra Vista Subwatershed do not arise due to insufficient available groundwater supplies. There is ample groundwater in storage to serve the municipal and industrial needs of the current and future residents of the [subwatershed]. [However, even] modest withdrawals from storage have some impact on the regional water balance, and without mitigation, have the potential to impact conditions of the SPRNCA.
2) The challenge facing the community is to develop a water resources plan that recognizes the needs of [the various] water users [in the subwatershed].

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3) The groundwater system that supplies the residents of Sierra Vista is an integral component of the hydrologic system of the entire subwatershed and is hydraulically connected to the surface waters of the SPRNCA.

4) Each increment of water use in the Sierra Vista Subwatershed, whether it is from increased consumption by riparian vegetation or groundwater pumping changes, to some degree, the hydrologic system of the subwatershed. Significant increases in riparian vegetation would likely result in increased evapotranspiration and reduce the flux of groundwater to the surface water system much like the effects of groundwater pumping adjacent to the San Pedro River. These changes would likely result in decreased streamflow in the San Pedro River.

5) There are inherent conflicts between groundwater pumping that accompanies economic development within this connected hydrologic system and the water resources required to sustain the riparian ecosystem of the SPRNCA. However, the location of the groundwater extractions relative to the San Pedro River bear directly on the degree and timing of impacts to the river. The municipal and military water uses that have occurred to date in the Sierra Vista/Fort Huachuca area have had a much less direct impact on the flows in the San Pedro River than have either drought or the groundwater pumping associated with the agricultural uses in the Palominas/Hereford area. Any impacts to the San Pedro River that may have occurred from the groundwater pumping in the Sierra Vista/Fort Huachuca area appear to be very limited to date and are likely the result of a small reduction in the upward vertical gradients in the basin fill aquifer lessening the groundwater fluxes to the floodplain aquifer of the San Pedro River.

6) Declines in regional aquifer water levels at some distance from the San Pedro River are not necessarily an appropriate measure of impacts of groundwater pumping on streamflow. Such impacts are best assessed through consideration of the basin water balance.

7) [Various investigators] believe that a water resources management strategy can be implemented within the region which, if properly designed and monitored, will abate potential negative impacts to the SPRNCA due to increased pumping.

8) The growth and development that has occurred in the Fort Huachuca/Sierra Vista area does not pose an immediate threat to the flows in the San Pedro River within the SPRNCA. Additional unmitigated groundwater pumping to serve new development will increase the threat to the San Pedro River. At the present time, much effort and resources are being expended on improving the existing modeling efforts.

A.2.17 Historical Flows and Conditions in the San Pedro River (Geraghty and Miller 1995)

The Water Action Task Force of the Sierra Vista Economic Development Foundation commis-sioned a consulting firm to investigate the historical (pre-development) flow regime of the San Pedro River. Results of this study were meant to aid decision makers in planning and managing local water resources. The report provided a comprehensive review of historical accounts and scientific evidence regarding past conditions in the San Pedro River basin.

The investigators concluded that historical flows and conditions of the San Pedro River have undergone significant changes. Before the 1850s the river was unincised and meandered through marshy areas and beaver ponds. By the late 1800s, rapid settlement of the valley, watershed degradation, climatic changes, and a major earthquake caused entrenchment of the river channel and the subsequent lowering of the regional water table. The establishment of a riparian gallery forest (where none had been before) was found to correlate with the systematic decline in the river base flow. Changes in the flow regime have been continuous over the past 300 years and have resulted from a complex interaction of cultural and natural causes. The investigators reasoned that the issue of preserving historical flows in the San Pedro River requires decisions to be made as to which transitional condition the public wishes to preserve.

A.2.18 Upper San Pedro Basin Model (W&EST 1996)

At the request of the Gila River Indian Community in 1987, W&EST began to develop a mathe-matical model of the hydrologic regime of the San Pedro River Basin. Progress reports on the modeling efforts were produced in 1993 (discussed in section A.2.14), 1994 and 1996. The goal of the model has been to use the model as a tool to define and quantify past impacts of water use in the San Pedro Basin on the availability of water to the Gila River Indian Community. The model is intended to be used for negotiations. The model domain includes the entirety of the basin within the United States, so that the model can be used to model outflows from the San Pedro Basin into the Gila River. The model depicts regional hydrologic conditions and is not intended to simulate local or site-specific hydrologic conditions.

The 1996 progress report includes additional water use and hydrogeologic data. Calibration efforts are continuing. The 1996 report describes a steady state model that simulates pre-development conditions before 1880, and a transient model that simulates historical surface water and ground-water conditions from 1880 through 1988. The model uses the U.S. Geological Survey MOD-FLOW code. The model is comprised of two layers with grid cell dimensions of 0.5 by 0.5 miles. Model input inflows include recharge from precipitation along mountain fronts, recharge from flood runoff, groundwater inflow from outside the model boundary, surface water inflow from Mexico and groundwater recharge from wastewater effluent.

Model ouflows include streamflow, ground-water underflow, evapotranspiration, river water evaporation, pumping and stream diversions. The model output includes historical groundwater levels and flows in the San Pedro River. Agricultural return flows are not accounted for. The 1996 progress report addresses concerned raised on the earlier versions about the sensitivity of the model results to changes through time in riparian vegetation and evapotranspiration rates, channel incision, use of baseflow versus mean annual streamflow as model input, large grid cell sizes and elongated geometry of the grids.

The steady state and transient models were used to assess the impacts of pumping by individual water users groups on flows in the San Pedro River. The Sierra Vista/Fort Huachuca area is the only area of the Upper San Pedro Basin with sufficient water level data to map changes through time. A series of steady state and transient simulations were made in which pumping from only one of eight pumping groups was modeled, and river flows were compared with base runs in which no pumping was modeled. The results indicate that 94 percent of the historical river flow loss through 1988 in the Upper San Pedro Basin is due to agricultural pumpers along the San Pedro River who have used 75 percent of the groundwater and surface water through 1988. How-ever, if 1988 pumping rates were continued into the future until steady state was achieved, the model predicts that the agricultural pumpers, who use 67 percent of the water, would be responsi-ble for 76 percent of the lost river flow, but only 25 percent of the lost evapotranspiration. Accord-ing to model results, the municipal users in the simulation, who use 33 percent of the total water, are responsible for only 24 percent of the lost river flow but for 75 percent of the lost evapotrans-piration. If pumping remained at 1988 levels, the model predicts that the flow in the river would continue to diminish in most reaches as the cones of depression from pumping by more distant communities enlarge and increase their impact on the river. Note that pumping by Fort Huachuca was nearly 50 percent higher in 1988 than in 1997.

The W&EST model indicates that pumping by Fort Huachuca through 1988 is responsible for approximately 0.1 cfs or 2 percent of modeled streamflow loss at Charleston and 0.17 cfs or 3 percent at Tombstone under transient conditions and a maximum of 1.2 cfs or 13 percent at Charleston and 1.7 cfs or 16 percent at Tombstone under steady state conditions, assuming pumping at 1988 rates. The model report does not indicate how long it would take to reach steady state conditions but states that it is probably considerably longer than the length of time of histori-cal development. The model summarizes the total steady state flow loss from Fort Huachuca as 3.3 cfs at the Benson Narrows (only summarized at this location), based on modeled pumping of 3.4 cfs. In that analysis, model results show that Fort Huachuca contributes 8.6 percent of the total modeled flow loss of the San Pedro River, based on a total simulated flow loss contributed by all water users of 38.2 cfs.

The W&EST report cautions that all numbers in their report should be used as estimates only because exact hydrologic conditions are not known and that modeled river flows are very sensi-tive to starting conditions such as initial river stages, aquifer water levels, evapotranspiration, etc. and also to mathematical starting conditions caused by the model's iterative solver. Based on a sensitivity analysis, modeled water levels are most sensitive to changes in hydraulic conductivity and recharge rates. Modeled water levels are sensitive to river flows when evapotranspiration is high. Modeled river flows are most sensitive to the amount of tributary runoff modeled because this runoff flows directly into the river. The river flows are also sensitive to the riverbed geometry and silt layer hydraulic conductivity and thickness because these parameters restrict the flow of groundwater into the river.

The W&EST report compares their model with the ADWR groundwater flow model of the Upper San Pedro Basin (Corell et al. 1995, from W&EST 1996). The ADWR model simulates only the baseflow component of the San Pedro River flow. As a result, the ADWR model can only simulate evapotranspiration at rates reduced to the theoretical levels that would be sustained by ground-water inflow only from the basin-fill alluvium. This type of model accentuates the effects of pumping during the dry months of the year. Both the W&EST steady state and transient models were converted to baseflow models by removing all tributary runoff and significantly reducing the evapotranspiration rates. The modeled river flow were compared to historical baseflow values estimated by ADWR in their 1995 model. The W&EST model was modified to model only base-flows by reducing the evapotranspiration rate to one-third of that used in the calibrations and by reducing the simulated inflow to the model in the San Pedro River from 28 cfs to 1.5 cfs. The modeled baseflows were in the general range of the ADWR estimates but declined steadily throughout the simulation rather than declining in the 1940s and increasing in the late 1970s. The W&EST modelers tried to match the

ADWR estimated baseflows by doubling the modeled evapo-transpiration rates in the 1940s and reducing the rates in the 1950s, 1960s and 1970s, but considered those conditions physically unrealistic.

The W&EST report reflects a continuing modeling effort and describes progress to date. The modeled groundwater levels are most sensitive to changes in hydraulic conductivity and re-charges rates while modeled river flows are most sensitive to the surface water inflow volume from tributary runoff. The authors state that future work may modify the modeling results des-cribed in the report. Future work may include updating pumping data through 1994 or 1995, and changes in the transient model. Currently, the model consists of twelve stress periods, the shortest of which is three years. Water uses and supplies are averaged for each stress period. The model should be improved to simulate changing use and supply patterns throughout the year, probably on a monthly basis, in order to allow better forecasting of the effects of water use on river flows during dry times of the year. This improvement would enable modeling of flood flows during monsoon seasons and baseflows at other times.

A.2.19 A Groundwater Flow Model of The Sierra Vista Subwatershed of the Upper San Pedro Basin - Southeastern Arizona (Corell et al. 1996)

This report describes the latest in a series of groundwater models developed for the Upper San Pedro Basin by the Arizona Department of Water Resources. The purposes of this model are to expand the model area from previous studies to incorporate new areas of concern and to develop an analytical tool capable of providing answers to questions concerning the effects on the San Pedro and Babocomari Rivers, their associated riparian areas and floodplain alluvial aquifers, and on the regional groundwater system. The ADWR is interested in modeling the effects of municipal and non-agricultural growth at Sierra Vista and Fort Huachuca, retirement of agricultural lands or increased agricultural activities, municipal and agricultural conservation measures, recharge projects, future development adjacent to the San Pedro River on baseflow and seasonal varia-tions in groundwater levels, river flows of a fully restored riparian system, long term drought, and increased Mexican groundwater use. The model is designed to provide a regional understanding of the interrelationships between the groundwater flow system and groundwater pumpage and recharge. It is not designed to address site-specific problems, seasonal variations in groundwater levels and river flow, and precise water levels and elevation changes.

The area of study includes the Sierra Vista, Huachuca City, Fort Huachuca, Palominas, Hereford, Charleston and Fairbank areas. The total model domain is 22 miles from east to west and 32 miles from north to south. Model cell sizes range from 40 to 160 acres. The model represents the Upper San Pedro Basin as consisting of a regional aquifer and a floodplain alluvial aquifer. The year 1940 was chosen to represent pre-development steady state conditions on the basis of limited groundwater development and the availability of water level and stream gage data. The Freethey (1982) and Vionnet and Maddock (1992) models also used 1940 to represent pre-development conditions. The years 1941 to 1990 were selected to represent the post-

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development period for the transient simulations. The model uses the MODFLOW code developed by the U.S. Geological Survey. Three model layers were used to represent the hydrogeologic system.

Input data for the model were obtained from Freethey (1982), both specified and unspecified published data, map analysis and estimates by ADWR. Municipal and military pumping records were used in the simulations. (Note: Pumping by Fort Huachuca was significantly higher during the simulated period than at present.) Agricultural pumpage was estimated. Evapotranspiration estimates only include the groundwater-supplied portion of evapotranspiration. Therefore, these estimates are less than the total use by riparian vegetation. Also, due to the method used to estimate baseflow, near-stream pumpage was overestimated resulting in an overestimate of the effects of groundwater pumping on river inflows and outflows. The estimates of riparian, agricul-tural and evaporative losses may be smaller than previous estimates because they only include the portion of riparian, agricultural and evaporative uses derived from groundwater discharge to the San Pedro River and not the additional amount of evaporative losses supplied by flood flows, tributary inflows and rainfall.

According to the model report, the major change in the San Pedro River and the associated groundwater system over the past 50 years has been a decrease in groundwater discharge to the river between the years 1935 to 1940 and 1951 to 1956. The model report indicates that average baseflows have decreased through time from 1951 to 1980. However, the report also states that there may have been an increase in average baseflows for the period 1981 to 1990.

Based on a number of statistical comparisons of measured versus simulated conditions, the model appears to reasonably simulate measured water levels. Improvements in model-estimated streamflow could be made with improved estimates of evapotranspiration and recharge. In addi-tion, the conceptual estimates of baseflow may include some component of runoff not accounted for in the model and may include some effects of near-stream pumping. The results of a sensitivity analysis indicate that the model is low to moderately sensitive to changes in streambed conduct-ance, evapotranspiration depth and vertical conductance. The model is more sensitive to changes in evapotranspiration rates, especially in terms of fluxes and streamflows. The ADWR recom-mends that the model be updated as data become available to improve model calibration. Con-tinuing acquisition of new field data is necessary for future improvements due to many unan-swered questions about aquifer parameters, mountain front recharge, evapotranspiration and geology. The model could be improved by further analysis of the spatial and temporal distribution of pumpage, especially with respect to agricultural pumpage and the vertical distribution of pumpage within the aquifer. As the model is currently constructed, with stress periods are as long as 13 years, the model is not able to account for seasonal variations in pumpage, streamflow and evapotranspiration.

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A.2.20 Analysis of Hydrologic Data Collected by the U.S. Bureau of Land Management (1987-1995) and Recommendations for Future Monitoring Programs (Sharma et al. 1997)

Another recent hydrologic analysis has been conducted by Sharma, MacNish and Maddock (1997). This study analyzed stream flow and groundwater data collected by the U.S. Bureau of Land Management on the San Pedro and Babocomari Rivers. The purpose of the study was to establish a more efficient monitoring program for the SPRNCA. The report analyzed data on stream flow measurements taken at nine locations on the San Pedro River and one location on the Babocomari River, and groundwater levels in eighteen wells collected from 1987 to 1996. All of the stream discharge data and some of the groundwater level data were collected at non-systematic intervals, and the stream flow measurements may not have been collected at the same location at each site over time. The authors reached qualitative conclusions and suggested that the amount of groundwater entering certain stream reaches had diminished over the period of record (1987-1995) but indicated that their analysis was made difficult by inadequate documenta-tion, inconsistent procedures and malfunctioning equipment. The report did not recommend future groundwater data collection efforts at the wells at these sites but did suggest that wells specifically designed to monitor the interactions of the regional and floodplain aquifers and the river should be instrumented to capture data on a daily basis, and that data from such stations can be used to verify model calibration in the future. The report concludes that existing groundwater models of the basin, and the expected improvements to them in the next few years, will make it possible to anticipate the effects of groundwater perturbations on the San Pedro River.

The authors made numerous suggestions to improve the surface water monitoring program. Sug-gestions included assuring that changes in the present relationships between the BLM sites and the Charleston gage can be identified and quantified, develop better relationships between the Palominas Gage and the International Boundary and Hereford Bridge site, maintain the Fairbank site and use it to generate flow data at Tombstone and Summers, obtain better flow data for the Babocomari, improve the utility of the streamflow data with groundwater data, and improve gaging station documentation. The study reports measurements on the Babocomari ranging from no flow to 1.5 cfs for intermittent gaging between 1990 and 1995. However, Sharma et al. (1997) were not happy with their data and state that an accurate data set of generated surface flows at this site was not feasible.

A.2.21 Preliminary Interpretation of the 1997 Airborne ElectroMagnetic (EM) Survey over Fort Huachuca, Arizona, and the Upper San Pedro River Basin (Wynn and Gettings 1997)

In 1996 and 1997, Wynn and Gettings, under the supervision of the USGS, collected airborne electromagnetic data for subsurface structural investigations on Fort Huachuca and the Upper San Pedro River Basin. The study provides a preliminary interpretation of the March 1997 Upper San Pedro River basin airborne geophysical survey. Interpretations were based on limited data released to the USGS as of early May, 1997, comprising of (a) uncalibrated mathematical inversions of seven flight lines of the 60-channel airborne electromagnetic data, (b) a merged aeromagnetic map, (c) a graphic representation of the flight-lines, and (d) 6 grids representing x- and z-components of channels 2, 6, and 10 (early, middle, and late decay times corresponding to shallow, intermediate, and near maximum depths of penetration of the airborne EM system) (Wynn and Gettings 1997).

This study found preliminary evidence that suggests the existence of a shallow depth conductor and an intermediate depth conductor that underlies the shallow conductor. Wynn and Gettings (1997) report that based on drilling and ground geophysical surveys this intermediate conductor appears to be a clay body that may block the shallow aquifer between Fort Huachuca and the San Pedro River. While it remains unclear from these limited data how this structure affects water movement in the aquifer, isotopic evidence reported elsewhere, and the appearance of the inter-mediate conductor both suggest that there is at least some natural isolation between the recharge areas west of Fort Huachuca and much of the San Pedro River in the surveyed area (Wynn and Gettings 1997). The study also cites that if this natural isolation exists, then much if not most of the water in the SPRNCA must derive from the upper reaches of the San Pedro River drainage in Mexico (Wynn and Gettings 1997).

A.3 MITIGATION STUDIES

The general purpose of these studies was to examine various water management alternatives for the City of Sierra Vista or Fort Huachuca. A common theme in these reports was the proposal to mitigate the negative effects of groundwater overdraft by recharging the aquifer with stormflow or treated effluent.

A.3.1 City Of Sierra Vista Surface Water Plan (SLA 1988)

The City of Sierra Vista commissioned a consulting firm to prepare a comprehensive surface water plan for the City and surrounding area, including Fort Huachuca. The purpose of the study was to present a regional approach to the future management of surface water runoff within the study area. The intent of the plan was to provide means to protect the public against flood and erosion hazards, while treating surface water runoff and natural drainage ways as amenities to be managed. Phase 1 of the study involved a hydrologic and hydraulic investigation of Sierra Vista and surrounding areas. In Phase 2, these data were used to develop and evaluate alternative surface water management schemes. Phase 3 entailed combining the preferred alternatives into a comprehensive surface water management plan for the study area.

The results of this surface water study provided valuable baseline data on the hydrology and hydraulics of Fort Huachuca's and Sierra Vista's drainage systems. Such information could be used in locating and designing flood flow detention/retention facilities, both on- and off-post, for use as groundwater recharge sites. One notable recommendation made in the report is the construction of a conventional earth-filled dam on Garden Canyon Wash for flood control, recreation, and water resources purposes. About one-half of the proposed dam would be located on Fort Huachuca and would create a perennial lake with a maximum surface area of approximately 87 acres, and a maximum depth of 30 ft.

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A.3.2 Groundwater Recharge Feasibility Report (ASL 1995)

The City of Sierra Vista retained the services of a consulting firm to determine the feasibility of using sewer effluent to recharge the local aquifer. The study evaluated the potential impacts to the groundwater system and the San Pedro River of: 1) continuing current effluent disposal practices, 2) recharging effluent to maximize augmentation to river flows, and 3) recharging effluent at various other locations. The investigators reviewed previous hydrologic studies and employed an existing groundwater model (MODFLOW: Vionnet and Maddock 1992 version) to predict the effects of effluent recharge. In addition, they assessed the relevant regulatory requirements and estimated the cost of constructing and operating an effluent recharge system. It should be noted that this study examined the effect of future increased water use by Sierra Vista only; future water use by all other communities was held at 1995 rates.

In general, the ASL investigators concluded that a number of feasible effluent recharge strategies would allow for continued pumping by the community while preserving and enhancing flows in the San Pedro River. Other conclusions were:

Groundwater and surface water flow simulations demonstrated that continued and escalated groundwater pumping in the Sierra Vista/Fort Huachuca area will not result in an immediate, catastrophic decline in flows in the San Pedro River. These stream flow declines will occur gradually as the groundwater system changes in response to the pumping. The cone of depression will expand. The capture of mountain front recharge will increase in both volume and area extent, and groundwater gradients approaching the river will decline. However, sufficient time exists for the implementation of mitigation strategies to offset these undesirable outcomes.

Cost effective solutions are possible within the locally available water resources which can maintain and even enhance San Pedro River baseflows.

Mitigation strategies are possible which allow for continued development within the City of Sierra Vista without harming the San Pedro River.

It would be prudent to address the potential impacts to the groundwater system and the San Pedro River from existing and proposed development in other portions of the Subwatershed. Similar water resource strategies to those presented for the Sierra Vista area may be implemented throughout the Subwatershed.

Unmitigated growth throughout the Subwatershed has the potential to offset any potential benefits to the San Pedro River accrued through the implementation of the water management strategies recommended in this report.

Implementation of the recommended strategies contained in this report, coupled with a negotiated settlement among the competing water interests in the Subwatershed, has the potential to create water resources certainty with the community for the foreseeable future.

A.3.3 Sierra Vista Wetlands and Reuse Study (BOR 1995)

In 1991, the City of Sierra Vista in cooperation with the U.S. Bureau of Reclamation (BOR) initiated a study to evaluate the use of constructed wetlands to improve the City's wastewater management system. The purpose of the study was to determine the feasibility of employing treated effluent for various beneficial uses, including wetland creation, groundwater recharge and river flow augmentation. The investigators constructed and monitored two 3.5-acre pilot wetlands at the City's wastewater treatment plant, and presented conceptual designs and cost estimates for full-scale constructed wetlands. After analyzing and comparing the various alternatives, the investigators found (among other conclusions):

- The highest ranking alternative was on-site groundwater recharge using recharge basins. Recharge basins provide maximum reliability, low energy cost (assuming they are gravity-fed), low initial cost, and very good design flexibility. As discussed in the Groundwater Recharge section of this chapter, recharge basins may be highly feasible at Sierra Vista and may be integrated with other alternatives to provide complete reuse of effluent.
- Groundwater recharge by injection wells ranked fourth. The potential problem of the wells becoming clogged by effluent not fully treated would require operation and maintenance costs greater than that for recharge basins.
- Surface-water augmentation of the San Pedro River using the abandoned Southern Pacific Railroad roadbed alignment ranked sixth. Besides maximizing surface-water augmentation, transporting reclaimed water by gravity-flow provided minimum energy cost and maximum reliability. Initial cost was increased by the number of manholes and air valves required.
- Although technically feasible, implementation of the groundwater recharge or stream augmentation options would require compliance with all relevant federal and state water quality standards and permitting processes. The investigators described the various environmental and cultural studies that would need to be conducted if treated effluent were discharged within the San Pedro Riparian National Conservation Area. They also mentioned the need for additional geologic studies if the groundwater recharge option was to be pursued.

A.3.4 Water Resource Management Plan for Fort Huachuca (USAG 1995a, 1995b)

The U.S. Army Garrison, Fort Huachuca, commissioned this study to evaluate, among other things, the potential for expanding the use of reclaimed waste water for irrigation and aquifer recharge. The Water Resource Management Plan includes 2 volumes. Volume 1 provided information on the hydrogeology, water use history, and the feasibility of groundwater recharge. Volume 2 described the landscape and irrigation master plan.

The Army has undertaken a multi-tiered water resource management program in order to effi-ciently manage and conserve Fort Huachuca's water resources. Some of the major parts of the Water Resource Management Plan are:

Use of Reclaimed Water for Irrigation: In the early 1970's, the Fort constructed secondary treat-ment facilities at the Wastewater Treatment Plants (WWTP). The Fort also constructed a re-claimed water distribution system to enable the use of reclaimed water (treated wastewater effluent) on the golf course and Chaffee Parade Field. This facility was one of the earliest projects which utilized reclaimed water in southeastern

Arizona. Presently, the reclaimed water system has been extended to facilitate the use of reclaimed water at the new Outdoor Sports Complex and the relocated Chaffee Parade Field. Improvements to the WWTP No. 2 will be completed in the Fall of 1995 (WWTP No. 1 was taken out of service several years ago and since, only the effluent holding/pumping facilities at WWTP No. 1 have been utilized). These improvements to WWTP No. 2 will enhance the quality of the reclaimed water allowing it to comply with the Arizona Department of Environmental Quality (ADEQ) rules and regulations for "open access" irrigation. As part of this study, the expansion of the reclaimed water system will be evaluated in an attempt to further reduce the demand for groundwater.

Use of Low Flow Plumbing Fixtures: The Fort has enacted regulations requiring that all plumbing fixtures in new construction and renovations of existing structures utilize a "low-flow" design. In addition to this, the Fort has installed "low-flow" fixtures on many of the existing facilities not scheduled for renovation in the foreseeable future.

Restriction of Non-Essential Water Use: The Fort has enacted regulations limiting the use of potable water for irrigation. The regulations being enforced restrict the permissible method of irrigating, time and day of irrigating, and duration of irrigation.

Stormwater Recharge: Concepts for the recharge of stormwater are under investigation by the Fort as part of the Mountain Front Recharge Project. Concepts include peak flow harvesting, augmentation of in-stream infiltration, and other techniques to promote the infiltration of stormwater back to the local aquifer.

Educational Programs: The Fort has undertaken several programs to educate the population of the Post as to the value of the water resource and methods to reduce consumption.

Intergovernmental Coordination: The Fort has taken an active roll in intergovernmental coor-dination to assist in formulating a comprehensive plan which addresses the needs of all water interests within the San Pedro Basin.

The purpose of the Landscape and Irrigation Master Plan was to provide policies and standards for the planning, design, construction, and maintenance of landscape and irrigation improvements associated with new facilities to be constructed at the [Fort]. The Plan was also designed to be used in the redevelopment and upgrading of existing landscape and irrigation facilities. The prin-cipal goals of the Landscape and Irrigation Master Plan were given as follows:

- To create landscapes on the [Fort] that are compatible with the climatic and other environmental conditions present at Fort Huachuca.
- To create and maintain functional and attractive landscapes that support the missions that have been assigned to [the Fort].
- To utilize whenever and wherever appropriate, drought tolerant native or naturalized plant species in conjunction with [Fort] landscape developments.
- To create and foster a water conservation ethic within the Fort Huachuca community.

- To minimize the consumptive use of water for the irrigation of [Fort] landscape plantings.

A.3.5 Increasing Recharge from Mountain Front Precipitation and Runoff (SAIC 1997)

This project is a part of Fort Huachuca's program of water resources protection which includes water quality, water conservation, effluent reuse and recharge. The overall purpose of this project is to develop and implement a program to improve recharge at Fort Huachuca with the ultimate goal of increasing the recharge into the regional aquifer, thereby reducing or mitigating the drawdown caused by local ground water pumping.

Storm water runoff for major watersheds and the cantonment area of Fort Huachuca was analyzed. Seven major watersheds were delineated for the installation. The potential for aquifer recharge from storm water events was analyzed, the watersheds or areas that have the greatest potential to increase ground water recharge were determined, and recommendations for ground water recharge projects were developed. The report includes a summary and discussion of results obtained from an evaluation of recharge methods, selection of recharge methods and sites, baseline and projected recharge analyses, and conceptual design of recharge systems.

Preliminary watershed and surface water analyses indicated that several of the delineated basins may be suitable for developing sites where storm runoff could be captured or detained to enhance recharge. A number of watersheds offer the best potential for capturing runoff from these types of storms including Tinker/Brown, Woodcutters, Blacktail and Huachuca Creek. The potential cantonment sites include Hatfield Ditch, Arizona Ditch and Soldier Creek.

The east range was also evaluated for potential recharge sites. East range sites include Grave-yard Gulch north of Sierra Vista and near the southern boundary of the Reservation, Soldier Creek north of Sierra Vista near the southern boundary of the east range, and at its confluence with drainages from Libby Army Air Field-Sierra Vista Municipal Airport, and two large drainages entering the east range from the vicinity of Libby Army Air Field-Sierra Vista Muncipal Airport.

The Soldier Creek North and Libby sites appear to offer the best potential to collect and recharge storm runoff. Pending site-specific subsurface investigations, the runoff collection and recharge methods selected for the canyon drainages, i.e., infiltration galleries and vadose zone wells, are also applicable for the east range sites. Impoundment dams could be constructed since land is available, but at greater cost. A series of check dams on the drainages would also retain storm runoff which could either be allowed to infiltrate into the shallow subsurface, or storm water could be decanted and recharged deeper in the subsurface through wells or seepage trenches.

A summary of potential annual runoff and recharge for all sites investigated is presented in the report. The total potential annual runoff available from all of the sites investigated is 5,067 acre-feet. The canyon sites

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provide 90 percent or 4,536 acre-feet of that total. The east range sites account for 393 acre-feet, which is 8 of the total. The detention basin sites can provide 128 acre-feet of water, which is 3 percent of the total runoff.

The report recommends that recharge systems be implemented at Huachuca Creek and then Soldier Creek, followed by Woodcutters or Blacktail Creek. For the east range sites, the order of implementation should be Soldier Creek North and then the Libby drainage. Site-specific subsurface investigations should be performed prior to final selection of recharge methods and system design.

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APPENDIX B SPECIES DESCRIPTIONS

Potential direct impacts on federally listed threatened and endangered and candidate species and habitats include habitat loss, wildfire, noise, direct mortality, human disturbance, and erosion. Indirect impacts include potential impacts from Fort Huachuca groundwater usage and erosion resulting from fire or human disturbance.

Many Fort Huachuca activities are infrequent, occur in the cantonment area, use existing facilities, or involve small numbers of personnel and vehicles on existing roads and trails. These activities are unlikely to have direct impacts on species or habitat of concern and are not evaluated in great detail as separate direct impacts. However, the potential impacts of these activities are considered in the indirect and cumulative impact analysis. Activities with minimal direct impacts include most administrative activities, activities confined to the cantonment or buildings, and some testing missions.

B.1 POTENTIAL IMPACTS

Implementation of projects is not part of the proposed action; however, this section (B1) provides a preliminary identification of potential impacts should the projects be implemented in the future. This information is intended to help focus future specific NEPA analysis at the time a decision is made to implement a given project.

B.1.1 Habitat Loss

Minimal habitat loss will result from programmed facilities management activites at Fort Huachuca. All proposed construction projects occur within the cantonment area and only one proposed project will occupy lands not previously disturbed. This single project, the proposed RV park expansion will remove approximately 5 acres of greatly altered semi-desert grassland vegetation consisting primarily of mesquite and grasses adjacent to the existing RV complex. This negligible loss of grassland habitat will result in the loss of habitat for some wildlife species. This land is not within a protected agave management area and no listed or candidate species are known to occupy the area.

Training activities include weapons training on the South and East Ranges. Weapons training includes mortar and small arms training. Mortar firing would continue to occur on the East Range at current levels from firing pads across the East Range into impact Area Zulu, an area that has been an impact area since World War II. Small arms firing would occur on the South Range with existing targets, roads, and firing locations. Vehicle travel within ranges is limited to existing roads and trails between firing areas and target areas. Additional habitat loss is not anticipated as a result of continued weapons training.

Troop marches and vehicle convoys take place on existing roads and trails across the installation. Roads and trails are already devoid of vegetation; however, vegetation along the edges may be further impacted as these areas are used. Cross-county foot travel would not result in any habitat loss. The use of bivouacs across the installation will not result in habitat loss.

B.1.2 Fire

B.1.2.1 Fort Huachuca

Accidental wildfires associated with on-going and future operational activities could result in impacts to federally listed species and habitats including direct mortality, direct habitat destruction or degradation, and indirect destruction or degradation of habitat through post-fire flooding, erosion, and sedimentation. Fire risk would be associated primarily with weapons training and with exhaust systems of other vehicles. Tracer rounds are often used with machine gun fire, and these contribute to increased fire danger during training operations. The use of tracer rounds may be prohibited by Range Control during extremely dry periods. Vehicle traffic is limited to existing roads and trails at all times, where fuel load is relatively low. The Range Control Officer and Fort Huachuca Fire Chief are responsible for determining fire risk based on climatic conditions and trends, using the National Fire Danger Rating System.

Fire history data have been collected at Fort Huachuca since 1973 with a gap from 1975 to 1977 (ENRD 1997a). Most areas of Fort Huachuca have experienced no more than one fire greater than one acre in size every ten years (ENRD 1997a). Higher incidences of wildfires occur in training area Tango in portions of the area used for live ammunition fire. These areas consist predominantly of open grassland, mesquite-grass savanna, oak-grass savanna, and oak woodland vegetations.

Fire impacts, particularly in grasslands, are generally short-term. In addition, it is estimated that fires in grasslands in the Fort Huachuca area historically occurred every 7 to 10 years. Grass cover is substantially reduced during the first year after a fire. Various studies have shown that grasslands will recover from fires in 2 to 4 years (Finberg 1994, Bock and Bock 1992, Martin 1983).

The impact of fire varies depending on fire frequency and intensity, vegetation type, fuel load, and duration. For example velvet mesquite is very fire tolerant and most mature plants will sprout after a fire (Bock and Bock 1992, Cable 1965, DeBano et al. 1966, Martin 1983, Robinett and Baker 1966, White 1969). Palmer agave seedlings are easily killed by fire but adult plants appear to be fire tolerant (Robinett and Baker 1996).

Fires have been rare to nonexistent in the upper elevation plant communities (pine woodlands, pinyon/juniper and mixed woodlands) in the South Range during the 1973 to 1993 time period (see Figure 4.1-1). Fires on the West Range during this same time period have occurred in the open grassland and mesquite-grass savanna. Fires on the East Range have occurred in the western half of the range in the open grassland and shrubland (Chihuahuan Desert shrublands) plant community types (see Figure 4.1-1). Velvet mesquite and creosotebush are the most common shrubs in the Chihuahuan Desert shrublands; while mesquite is fire-tolerant as indicated above, creosotebush does not respond well to fire. This species suffered almost 100 percent mortality from fire in the Sonoran Desert (Brown and Minnich 1986, McLaughlin and Bowers 1982).

Fire suppression measures have the potential to have impact federally listed species through the establishment of fire lanes, staging areas, and other activities. These activities have the potential to impact species directly or impact their habitat.

Prescribed burns have the potential to impact federally listed species. Although every reasonable precaution will be taken, prescribed burns could become more intense than planned and burn more area or more vegetation than anticipated. This could cause an increase in erosion, subsequently affecting species such as the water umbel. If the burn escaped its preplanned boundaries it could also burn sensitive species habitat. Every reasonable precaution will be taken to minimize adverse impacts of prescribed burns to federally listed species and their habitat.

B.1.2.2 U.S. Forest Service land

Data regarding fires from Fort Huachuca entering U. S. Forest Service land (Coronado National Forest) is not available. However, the fire frequency map for the period 1973 to 1993, shows that there have been very few fires along the Fort Huachuca-Coronado National Forest boundary (see Figure 4.1-1). Two fires occurred at this boundary in the area of Scheelite and McClure Canyons during this time period and it is not known if they spread on to Forest Service land. Information from the Coronado National Forest indicates that there have been over 2200 fires on the national forest from 1980 through 1997 or an average of 122 fires per year (Kerrigan 1998). Of the fires on the Coronado National Forest, 1325 (61 percent) were started by lightning, 443 (20 percent) by camp fires, and the remainder from various causes such as smokers, equipment, arson and other miscellaneous causes (Kerrigan 1998).

B.1.2.3 San Pedro River

Much of the eastern boundary of the East Range borders on the SPRNCA. Fire data from 1973 through 1993 indicates that very few fires have occurred on the East Range with the closest fire to the SPRNCA being about five kilometers away. There are no records of fires spreading into the SPRNCA from the East Range. In addition, the Chihuahuan Desert shrublands and shrub-grassland plant communities cover the land which borders the SPRNCA and fires are rare in these types because of low fuel loads. Information from the BLM indicates there have been 36 fires in the SPRNCA from 1980 through 1996. The number of fires each year varied from zero to seven and the size varied from one to 323 acres in size. Most fires (24) occurred from May through August. Nineteen (53 percent) of these fires were caused by lightning, six (17

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percent) were caused by human fire use in the SPRNCA; four (11 percent) were caused by equipment, and the rest from miscellaneous causes. From this information, it appears that the probability of fire spreading from the East Range into the SPRNCA is remote. If a fire did start on the East Range, it would not likely travel far due to low fuel loads and fire suppression activities. In addition as shown above, an average of two fires per year occur in the SPRNCA due to lightning and human causes unrelated to military or other activities at Fort Huachuca.

B.1.2.4 Babocomari River

The northern boundaries of the East and West Range parallel the Babocomari River (see Figure 1.1-1). Fire data from 1973 through 1993 indicates that fewer than ten wildfires have occurred on the West Range along the installation boundary. The Babocomari River is approximately 2.5 to 3 km from the installation along the West Range. There are no records of fires spreading into the Babocomari River area from the West Range. The probability of fire spreading from the West Range into the Babocomari River area is low. If a fire did start on the West Range, it would not likely travel far due to low to moderate fuel loads and fire suppression activities. Fires on the East Range are infrequent and none have been reported along the installation boundary. The Babocomari River is within 0.25 km from the installation along portions of the East Range. The Chihuahuan Desert shrublands and shrub-grassland plant communities cover the land that borders the Babocomari River along the East Range. The probability of fire spreading from the East Range into the Babocomari River area is remote because of the low fuel load. If a fire did start on the East Range, it would not likely travel far due to low fuel loads and fire suppression activities

B.1.3 Noise

Noise sources at Fort Huachuca would include construction; wheeled vehicle convoys; UAV testing and operation; recreation; aircraft operations; emergency ordnance detonation; and mortar, machine gun, and small arms firing. Aircraft operations, UAV operations, and mortar firing would be the primary noise sources of concern under continuing and proposed activities. Construction activities would be concentrated in the cantonment area, which does not provide habitat for any federally listed species.

Aircraft operations at LAAF include takeoffs and landings by helicopters, private and commercial planes, and military airplanes. For these ongoing activities, noise contours associated with LAAF follow an east-west orientation, with approximately 1,157 acres of land in the vicinity of LAAF exposed to noise levels of greater than 65 dBA (USACHPM 1997).

UAV operations at Pioneer and Rugge-Hamilton airstrips would generally result in low levels of noise. Operating levels of UAVs are low, because of the small size of UAV engines (USAIC&FH 1993a). Rocket-assisted takeoffs (RATO) occur infrequently, no more than 10 times annually. Rocket-assisted takeoffs may reach noise levels of 100 dB at the launch (USAIC&FH 1991), but these levels last for only 2.5

seconds (USAIC&FH 1993a). Noise levels at the minimum operating altitude of 3,000 feet AGL are attenuated to negligible levels on the ground.

Potential noise impacts resulting from the ongoing and proposed activities would include vehicle traffic and limited ordnance use. Low numbers of explosive ordnance are used at training area Zulu on the East Range, producing varying noise levels depending on the type of ordnance used. The greatest noise level produced would be attenuated to approximately 70 dB at a distance of one mile.

On the South and West Ranges, additional noise sources include vehicle training, troop movements, and small arms training. Vehicle noise would attenuate to less than 55 dBA at 1,000 meters. Small arms training would result in noise that would attenuate to less than 55 dBA at a distance of 1,000 meters from the firing positions.

B.1.4 Direct Mortality

Direct mortality of federally listed species may result from collisions with vehicles, training ordnance, or construction equipment. The probability of federally listed species colliding with vehicles is extremely low. Wildlife-vehicle collisions could involve operational activities such as convoys, vehicles used in training and testing, or civilian travel including contractors and recreational visitors. Installation policy, enforced by military police, prohibits travel at speeds greater than 35 mph on all roads except Whitside, Winrow, Squire, and the Canelo Roads, on which speeds are limited to 45 mph. Traffic on most roads on the South, West, and East Ranges is limited to 25 mph. Most recreational travel outside of the cantonment area is restricted to daylight hours.

The threat of trampling, crushing, collection, or harassment on federally listed species would be greatest in recreational areas. Garden Canyon area is the site of greatest potential for these impacts to occur on some federally listed species (Stone 1997).

B.1.5 Human Disturbance

Construction, operations, and recreation have potential to adversely impact protected species by increasing human presence in areas of occupied habitat. Human presence may cause species to alter foraging, breeding, or roosting behavior; if disturbance is prolonged or occurs during periods in which species are particularly sensitive, reproductive success or survival may be affected (Grubb and King 1991). Sensitivity to human disturbance varies among species and among individuals; some species or individuals may become sensitized to disturbance while others may become habituated (Knight and Gutzwiller 1995).

Training and testing operations tend to be concentrated in the lowland portions of the South and West Ranges and in the western portions of the East Range. These areas do not contain suitable nesting or roosting habitat for most listed and candidate species, but foraging habitat is present for bats and falcons.

Training and testing activities may result in short-term disturbance to these species when operational and foraging activities overlap temporally and spatially.

Most recreational activities will remain concentrated in Huachuca Canyon, and Garden Canyon (ENRD 1997a). Developed camping and picnic areas will continue to receive the most use within these canyons. Except for a small camping area in lower Garden Canyon and rental cabins in upper Garden and Split Rock Canyons, recreation is limited to daylight hours in these areas and therefore would not impact species foraging nocturnally.

B.1.6 Erosion

Erosion may be a direct impact, as in the case of operational activities that cause soil loss and habitat degradation, or an indirect impact following wildfire. The potential for erosion following fire depends on many factors, including the size and intensity of the fire, and vegetation rehabilitation and erosion-prevention measures employed after the fire.

As a direct impact, operational activities may cause soil compaction and a reduction in vegetative cover. Several factors contribute to increased opportunity for soil compaction and erosion to occur.

- improper road design, and maintenance
- dismounted foot traffic
- and moisture content of soils

Soil erosion potential is highest in areas of low vegetation cover and high topographic relief. In general, the South and West Ranges exhibit moderate erosion, largely because of fire breaks in the mountain areas. Erosion on these ranges is predominantly limited to the occurrence of dirt roads and fire breaks within the Huachuca Mountains (AZ ARNG 1997).

Erosion within the East Range is the highest on the installation, with sheet and rill erosion within the central portion of the range the most significant. Under training and management conditions associated with ongoing and proposed activities, sheet and rill erosion across the East Range was estimated to be approximately 0.34 to 0.58 tons per acre per year (ENRD 1997b). Through analysis and field observation, transfer of sediment from areas within the central zone of the East Range has been found to be deposited within the respective stream channels within a distance of approximately three to four miles. These findings suggest that, while significant erosion and sediment transfer continue to occur across the East Range, the extent of deposition is predominantly limited to areas within Fort Huachuca and not in the adjacent SPRNCA (AZ ARNG 1997).

B.1.7 Groundwater Use

While the existence and historical cause of the cone of depression in the Sierra Vista Subwatershed are generally agreed upon in the literature, there has been considerable debate regarding the impact of groundwater use at Fort Huachuca on baseflow that sustains surface flows in the SPRNCA (see Appendix A for cited material summaries).

The geologic and hydrologic evidence indicate that the use of groundwater by Fort Huachuca has not caused a change in groundwater discharge from the USPB to the SPRNCA and that groundwater use by the fort will not impact surface flow in the SPRNCA in the next 10 years.

Evidence has accumulated which indicates that even under the assumption of one large, continuous aquifer, groundwater use at Fort Huachuca has not caused a change in groundwater discharge volumes and rates from the regional aquifer of the UPSB to the San Pedro River (ADWR 1988, 1991; Putman 1996).

Hydrologic models indicate that no impacts to surface water flows in the San Pedro River have been observed to date resulting from groundwater use at Fort Huachuca (ADWR 1991, Putman 1996).

"The cone of depression in the Sierra Vista/Fort Huachuca area has not intercepted the river" (ADWR 1991, p.495) and while the report suggests that a certain amount of groundwater flow towards the river in the regional aquifer is being diverted into the cone of depression, it concludes that "fifty years into the future, the Sierra Vista/Fort Huachuca cone of depression [will still] not intercept the river" (ADWR 1991, p.495).

The ADWR (1991) model projects potential impacts to the SPRNCA resulting from regional groundwater use occurring by the year 2038.

Average base flows have decreased through time from 1951 to 1980. However, there may have been an increase in average base flows for the period 1981 to 1990 (Correll et al. 1996a).

Recent geophysical studies suggest that the assumption of one large, continuous regional aquifer may not be correct. Preliminary findings suggest at least some natural isolation between the Fort Huachuca recharge areas and nearby parts of the San Pedro River. If this is the case, then not only is there evidence to suggest that groundwater use by Fort Huachuca has not and is not currently having an impact on surface flows in the SPRNCA (as discussed above), but there is evidence to suggest that there is less of a potential that this groundwater will impact the SPRNCA in the future.

Wynn and Gettings (1997) conclude that while it remains unclear from limited data how this potential natural isolation may affect water movement in the aquifer, their findings, along with radionuclide tracer studies reported elsewhere (Pool 1997), both suggest that some natural isolation between the recharge areas west of Fort Huachuca and much of the San Pedro River in the surveyed area exists. The location of this potential isolation may correlate with the a volcanic center and parts of the Tombstone Caldera underlying the eastern margins of Fort Huachuca (Moore 1993). Geophysical studies confirm the presence of a volcanic body at the approximate confluence of the Babocomari and San Pedro Rivers. Pool (1997) conducted radionuclide tracer studies which indicate that more water is entering the San Pedro River system from lower elevations and possibly indicates a recharge source closer to the river than the Huachuca Mountains to the west. One reasonable interpretation of this data is that surface flow in the San Pedro River is more dependant on water recharge from east of the SPRNCA from the Mule Mountains than from the Huachuca Mountains.

Not only is the presence of surface water in the SPRNCA a result of geologic and hydrologic conditions, it is also a result of historic and current land uses, and vegetative and climatic conditions. Historic land uses, changes in floodplain vegetation, and erosional processes have also been studied to determine potential correlation with surface flow variability.

ADWR (Correll 1996b) modeled several groundwater flow scenarios of future groundwater and surface water conditions in the Sierra Vista Subwatershed. The results of this model indicate that agricultural pumpage had the greatest impact on percent changes in baseflow at Charleston, followed by effluent recharge.

The University of Arizona San Pedro Interdiciplinary Study Team concluded that pumping from the regional aquifer is not a major factor imperiling streamflow in the San Pedro River. The team noted that drought-related reductions in surface runoff and irrigation-related pumping from the floodplain aquifer are much stronger influences (Maddock 1994).

The establishment of riparian vegetation in the 1930s has significantly increased the evapotranspiration rates along the San Pedro River (Geraghty and Miller 1995). Qi et al. (1998) estimate total water loss from the riparian corridor along the San Pedro River to be approximately 48,270 tons per day. The daily evaporative water loss for the entire riparian corridor is estimated to be approximately 10 million gallons, or 30.7 ac-ft per day (Qi et al. 1998).

Historic evidence suggests that entrenchment of the San Pedro River up to 30 feet may have occurred with a consequent lowering of the water table adjacent to the river by the same 30 feet (Geraghty and Miller 1995). They conclude that the observed long-term water level declines in wells near the river may reflect this occurrence.

A recent groundwater study performed for the Gila River Indian Community concluded that 94% of the historical San Pedro River flow loss was due to agricultural pumping along the river (W&EST 1996).

Geologic and hydrologic studies presented in this section indicate that the use of groundwater by Fort Huachuca has not caused a change in groundwater discharge from the USPB to the SPRNCA and will not significantly impact surface flow in the SPRNCA over the 10-year period. Sufficient evidence exists to support the conclusion that groundwater use by Fort Huachuca will not impact any federally listed species or critical habitat.

B.2 COCHISE PINCUSHION CACTUS

B.2.1 Description

The Cochise pincushion cactus (*Coryphantha robbinsorum*) is a small unbranched cactus (5 cm or 2 in) tall with few, if any, central spines (SFB 1996b). The 11 to 17 white radial spines are long and needle-like. In juvenile plant, there are 10 spines, more even in length, white, and densely covered with fine hairs (SFB 1996b). The flowers of this cactus are bell-shaped and pale yellow-green in color while the fruit is orange to red in color when ripe (SFB 1996b).

B.2.2 General Ecology

This cactus occurs in semi-desert grasslands associated with small shrubs, agave, other cacti, and grama grass (SAIC 1996). This cactus inhabits the cracks of limestone rocks found on hilltops (SFB 1996b).

B.2.3 Status / Date of Listing

The Cochise pincushion cactus was listed as a federally threatened species on 09 January 1989. The USFWS (1986) did not designate critical habitat for this species because of its restricted distribution, accessibility, and the potential threat of collection by cactus collectors. This plant is classified as "highly safeguarded" by the Arizona Native Plant Law of 1993.

B.2.4 Distribution and Abundance in the Region and at Fort Huachuca

The Cochise pincushion cactus occurs in the southeastern corner of Cochise County and in adjacent Sonora, Mexico (SFB 1996b). The Cochise pincushion cactus is not known nor likely to occur on Fort Huachuca or the SPRNCA due to lack of suitable habitat (Warren 1996).

B.3 CANELO HILLS LADIES' TRESSES

B.3.1 Description

Canelo Hill's ladies' tresses (*Spiranthes delitescens*) is a slender, terrestrial orchid that inhabits riparian areas (USFWS 1997a). This plant reaches a height of 50 cm (19 in), with 5 to 10 grass-like leaves 18 cm (7 in) in length, and up to 40 small, white flowers arranged in a spiral at the top of the flower stalk (USFWS 1997a). While this species is presumed to be perennial, mature plants rarely flower each year and in some years may have no visible, above ground structure (USFWS 1997a).

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B.3.2 General Ecology

The Canelo Hill's ladies' tresses is found in cienegas (mid-elevation wetland communities often surrounded by arid environments) intermixed with tall grasses and sedges at an elevation of approximately 1,525 m (5,000 ft). The dominant vegetation associated with this plant includes bluegrass (*Poa pratensis*), Johnson grass (*Sorghum halepense*), scratchgrass (*Muhlenbergia asperifolia*), aparejo grass (*Muhlenbergia utilis*), sedges (*Carex* spp.), rushes (*Juncus* spp.), spike rush (*Eleocharis* spp.), cattails (*Typha* spp.), and horsetails (*Equisetum* spp.; Kearney and Peebles 1960; USFWS 1997a). The Canelo Hill's ladies' tresses grows on slopes near water where the finely grained, highly organic soil is seasonally or perennially saturated but well drained. This plant is rarely found where scouring floods occur (USFWS 1997a).

Successful seedling establishments of Canelo Hill's ladies' tresses are dependent on the forma-tion of endomycorrhizae (a symbiotic relationship with mycorrhizal fungi and plant root tissue; USFWS 1997a). Because these plants can remain in a dormant, below ground, or non-flowering state for consecutive years and because they grow in very dense vegetation, it is often difficult to estimate the population unless flowering stalks are present.

B.3.3 Status / Date of Listing

The Canelo Hill's ladies' tresses was federally listed as endangered on 05 February 1997. In addition, this plant is classified as "highly safeguarded" by the Arizona Native Plant Law of 1993. Critical habitat has not been designated for this plant species (USFWS 1997a).

B.3.4 Distribution and Abundance in the Region and at Fort Huachuca

Because of the occasional subterranean and non-flowering life-stages of the Canelo Hills ladies' tresses, it is difficult to estimate the historic distribution and population of this species. However, it has been estimated that up to 90 percent of the riparian habitat along Arizona's major desert waterways have been lost (USFWS 1997a). Because this species occupies small portions of these rare habitats, it is assumed the species has declined (USFWS 1997a).

Today, this plant is known to occur in southern Arizona in only four cienegas: one in Cochise County and three in Santa Cruz County. The Cochise County population, identified in 1981, is located approximately 3 km upstream and north of the fort on private land along the Babocomari River. This population has not been recently surveyed (Brooks 1998). Canelo Hills ladies' tresses are not known to occur on Fort Huachuca and no potential habitat for this plant is present on the fort (Warren 1996).

Overall, population numbers of the Canelo Hills ladies' tresses are believed to be declining (USFWS 1997a). However, it is unclear what factors are acting to cause the decline of this plant. It is suspected that a lack of disturbance, such as grazing or fire, may inhibit its success. Research at the University of

Arizona suggests that prescribed burns may stimulate reproduc-tion (McClaran and Sundt 1992). In an effort to gain a better understanding of the ecology of the Canelo Hills ladies' tresses, the Nature Conservancy has purchased one of the known sites and is monitoring the population (USFWS 1997a).

B.4 HUACHUCA WATER UMBEL

B.4.1 Description

The Huachuca water umbel (*Lilaeopsis schaffneriana* ssp. *recurva*; also known as the Cienga False-rush) is a herbaceous, semi-aquatic, perennial plant belonging to the parsley family (USFWS 1997a). This plant resembles chives and under optimal conditions can form dense mats of vegetation along stream margins (Warren 1997). This plant reaches up to 20 cm (8 in) and has bright yellow-green, cylindrical, hollow leaves with no pith (USFWS 1997a). The flowers of this plant (3 to 10) are very small and are borne on an umbel shorter than the leaves and arising from the root nodes. The fruits are round (1.5 to 2 mm or less than 1 in) in diameter and are usually slightly longer than they are wide (USFWS 1997a).

B.4.2 General Ecology

The Huachuca water umbel inhabits cienegas and associated vegetation within Sonoran desert-scrub (low elevation sites), grassland/oak woodland (mid-elevation sites), and coniferous forests (high elevation sites). This plant is found at elevations of 1210 to 1980 m (4,000 to 6,500 ft) and requires perennial water.

The Huachuca water umbel has an opportunistic life-history strategy that ensures its survival in healthy riparian systems of cienegas, wetlands, and low gradient streams. In the upper portions of watersheds, where scouring floods generally do not occur, the Huachuca water umbel occurs when interspecific plant competition is low. It can be found in these sites along the periphery of the moist channels where plant density is low (USFWS 1997a). In stream and river habitats, this plant can occur in side channels and backwaters. Following a flood event, it can rapidly occupy the disturbed site and flourish until interspecific competition exceeds its tolerance (USFWS 1997a). It appears that this species is best adapted to periodic, low-intensity disturbances (Warren et al. 1991a).

The Huachuca water umbel sexually reproduces via flowering and also asexually from rhizomes (USFWS 1997a). The rhizomes of this plant are often submerged 5 to 40 cm (2 to 16 in) in sand, mud and/or silt, making it difficult to identify individual plants (Warren and Reichenbacher 1991).

B.4.3 Status / Date of Listing

The Huachuca water umbel was listed as a federally endangered plant on 05 February 1997 and is a U. S. Forest Service (USFS) sensitive plant species. In addition, this plant is classified as "highly safeguarded" by the Arizona Native Plant Law of 1993. Critical habitat was not designated for this plant species (USFWS 1997a).

B.4.4 Distribution and Abundance in the Region and at Fort Huachuca

This subspecies was first identified in 1881 by A.W. Hill near Tucson. Historically, the Huachuca water umbel range was limited to southeastern Arizona and Sonora, Mexico (Warren et al. 1991a). Prior to 1988, this plant was known from only 7 locations in southern Arizona (Warren and Reichenbacher 1991).

Presently, the Huachuca water umbel occurs in southwestern New Mexico, southeastern Arizona, and adjacent Sonora, Mexico (USFWS 1997a). In Arizona, populations occur in Pima, Santa Cruz, and Cochise counties. While these populations could be defined as a meta-population, traditional meta-population analyses can not be performed on this species because not enough information is available regarding emigration and natural extinction of populations (Frye 1997). While it appears one population may be made up of two distinct subpopulations, speculation on populations should remain tentative until additional life-history information is available for this species (Frye 1997). Twenty-four sites have been documented in Arizona, six of which have been extirpated. The remaining sites occur in four major watersheds: the San Pedro River, Santa Cruz River, Rio Yaqui, and Rio Sonora (USFWS 1997a).

There are seven populations of this species on Fort Huachuca in Garden, McClure, and Saw-mill Canyons within the South Range of the base (SAIC 1996, Hessil 1998). Since 1995, Stone (1997) located three of these populations on Fort Huachuca: 1) in upper Garden Canyon in 1995; 2) in upper Garden Canyon in 1995; and 3) in a middle Garden Canyon pond at the mouth of Garden Canyon in 1996. It is not known how long these populations have existed in these locations (Stone 1997). A seventh population was located in McClure Canyon in late 1997 (Hessil 1998). In addition, surveys conducted by the University of Arizona have located additional populations in the region; the results of these surveys are not yet available (Frye 1997). Potential habitat for this plant may exist around the ponds in the southwestern corner of the East Range of Fort Huachuca (Stone 1996).

Erosion and stability of perennial water systems are the primary management factors of con-cern for this species. In addition, wildfires are of concern because of increased erosion, reduced water infiltration, and other negative impacts that can occur after a fire (Rinne and Neary 1996). Excessive rates of erosion and disturbance near a site from wildfires, recreation-alists, or road construction could increase the chance of a flash flood that could scour a population. Likewise, the reduction or diversion of water could eliminate a site (AGFD 1997b). This species is currently being monitored by an organization called the Friends of the San Pedro Docents.

B.5 BLUMER'S DOCK

B.5.1 Description

Blumer's dock (*Rumex orthoneurus*; also known as the Chiricahua dock) is a large, herba-ceous, mostly perennial plant in the buckwheat family reaching 1.2 to 2.0 m (47 to 79 in) high. The leaves are bright green, simple, alternating, approximately 50 cm (19 in) in length, and 25 cm (10 in) wide. These rounded leaves have principal, straight lateral veins that spread at nearly a right angle from the midvein (Kearney and Peebles 1960). *Rumex occidentalis*, a very closely related species with narrower leaves (width is less than half the length), is often misidentified as Blumer's dock.

B.5.2 General Ecology

Historically, the Blumer's dock occupied high mountain riparian areas, springs, and wet meadows with perennial water at mid to high elevations of 1,980 to 2,800 m (6,500 and 9,200 feet; Warren and Reichenbacher 1991). Today, the species occurs in wetlands with moist, organic soils adjacent to perennial streams.

B.5.3 Status / Date of Listing

This plant is a candidate for federal listing and is a "highly safeguarded" species by the Arizona Native Plant Law of 1993.

B.5.4 Distribution and Abundance in the Region and at Fort Huachuca

Historically, Blumer's dock occurred at mid to high elevations in the Chiricahua, Huachuca, and Sierra Ancha Mountains, and more recently in the Pinaleno Mountains (Warren and Reichen-bacher 1991). This plant is now distributed from east-central to southeastern Arizona (Kearney and Peebles 1960). Only one population of this species occurs on Fort Huachuca in the South Range within Scheelite Canyon (Tandy 1996). Surveys conducted in 1997 in other potential habitat on Fort Huachuca revealed no new populations(Tandy 1997). No suitable habitat exists within the East Range of Fort Huachuca for this plant species (SAIC 1996).

Though grazing has potentially impacted Blumer's dock, the most dominant threat comes from recreation. Blumer's dock habitat is popular among hikers, and the plant can be trampled (Thompson and Hodges 1996). To mitigate both of these factors, the Coronado and Tonto National Forests have been transplanting and introducing plants to suitable sites as well as constructing enclosures (Thompson and Hodges 1996).

B.6 LEMMON FLEABANE

B.6.1 Description

Lemmon fleabane (*Erigeron lemmonii*) is a small, flowering, prostrate perennial belonging to the sunflower family found in dense clumps on vertical cliffs (Warren et al. 1991b). This plant has stems spreading 10 to 20 cm (4 to 8 in) in length. The stems and leaves are covered with long, non-glandular hairs (0.4 to 0.6 mm long or 0.02 in). Flowers are daisy-like in appearance with white or light-purple outer petals and yellow inner petals at the end of leafy branches (Warren et al. 1991b). *Erigeron lemmonii* is distinguished from other *Erigeron* species by its characteristic prostrate growth habit (low, ground-level), its perennial nature, and its affinity for growing on vertical cliffs.

B.6.2 General Ecology

This plant grows in dense clumps (up to 0.5 m or 20 in diameter) within crevices, ledges, and boulders of rugged peaks and vertical, quartzite cliffs of the Huachuca Mountains (Warren et al. 1991b). But because of the inaccessible nature of the Lemmon fleabane, very little is known about the ecology or population biology of this species (Warren and Reichenbacher 1991).

B.6.3 Status / Date of Listing

Lemmon fleabane is a candidate for federal listing (Federal Listing 45:242, 1980), a USFS sensitive plant, and a "highly safeguarded" species under the Arizona Native Plant Law of 1993. It is an extremely rare species known from only a single location in southeastern Arizona, on Fort Huachuca. Low-intensity monitoring of the population has been recommended for this species (Warren and Reichenbacher 1991).

B.6.4 Distribution and Abundance in the Region and at Fort Huachuca

Historically its range was thought to include a wider area of Arizona. However, recent taxo-nomic analysis has indicated that Lemmon fleabane is endemic only to Scheelite Canyon of the South Range of Fort Huachuca in the Huachuca Mountains (Warren et al. 1991b). Surveys in 1991 for the Lemmon fleabane located 441 individual plants in Scheelite Canyon on two separate cliff faces. While no plants were found outside of Scheelite Canyon in surveys conducted in 1997, potential habitat may occur in other areas within Fort Huachuca (Warren et al. 1991b; Tandy 1997).

Unlike many other plant species, Lemmon fleabane may not be susceptible to human disturb-ance due to its relatively inaccessible cliff habitat. Potential threats to its continued success may include extended drought, falling rocks, and illegal rock climbing (Warren et al. 1991b; Stone 1997).

B.7 HUACHUCA SPRINGSNAIL

B.7.1 Description

The Huachuca springsnail (*Pyrgulopsis thompsoni*) is a very small (1.7 to 2.3 mm or 0.7 to 0.9 in) invertebrate mollusk belonging to the class Gastropoda. The shell of this snail is conical in shape. However, species identification must be accomplished by examining characteristics of the reproductive organ.

B.7.2 General Ecology

This species occupies the shallow areas of cienegas, often at the rocky seep of a springs source, between 1,370 and 1,830 m (4,500 to 6,000 ft) in elevation. These springs contain vegetation, have a slow to moderate flow, with firm substrates such as roots, wood, and rocks. Populations are locally abundant, but habitat within cienegas are limited.

B.7.3 Status / Date of Listing

The Huachuca springsnail was listed as a candidate species for federal listing in February 1996. Arizona has no state protection status for this snail.

B.7.4 Distribution and Abundance in the Region and at Fort Huachuca

The springsnail is found in springs of southern Santa Cruz and Cochise counties as well as northern Sonora, Mexico. In 1992, potential habitat (16 aquatic areas) was surveyed and nine populations were located within the South Range of Fort Huachuca in Garden, Sawmill, and Huachuca Canyons and in Cave Springs (SAIC 1996; USFWS 1997b; AGFD 1993). Currently, there are 8 populations within Huachuca and Garden Canyons (Hessil 1997). Potential habitat for the snail on Fort Huachuca exists in the limited aquatic areas of ciengas with a spring source (USFWS 1997b). Management concerns and threats to the species are related to habitat destruction by residential development, water diversions, recreational use, and livestock grazing (USFWS 1995d).

B.8 BALD EAGLE

B.8.1 Description

The bald eagle, *Haliaeetus leucophalus*, is an impressive, large raptor with a wingspan of 1.78 to 2.29 m (5.8 to 7.5 ft; NGS 1987). Females are typically larger than males. It has a large, brownish black body with snowy white head and tail and bright yellow bill, feet, and eye (Brown and Amadon 1989). Immature bald eagles can easily be distinguished from the golden eagle (*Aquila chrysaetos*) by the large head, heavier bill, and unfeathered yellow legs (Brown and Amadon 1989).

B.8.2 General Ecology

While this eagle breeds throughout most of North America, sizable breeding populations occur near sparsely human populated coasts, rivers, and large lakes. Bald eagles generally nest in forest stands near water that contain a mixture of tall, old, and dead and dying trees. Nest trees must be structurally suitable to hold a large stick nest.

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30 m (65 to 98 ft) within potential habitat. All field personnel had completed the southwestern willow flycatcher survey protocol training required by the USFWS before conducting field surveys.

During these surveys, all birds heard or observed were recorded by one of the Fort Huachuca biologist who was familiar with breeding birds in southwestern riparian habitats. In addition, notes on the habitat quality in relation to the southwestern willow flycatcher as well as areas of surface water were kept during each field trip

1997 Survey results - Habitat Evaluation. The results presented here are from surveys conducted by Fort Huachuca personnel. Specific details regarding BLM surveys are available from the BLM in Sierra Vista, Arizona. Southwestern willow flycatcher surveys took place during the third week in May, third week in June and first week in July, 1997. During the May survey, 19.8 km (12.4 miles) of the 20.6 km (12.9 miles) of San Pedro River surveyed contained flowing or standing water. By the June and July surveys, areas of standing and flowing water were reduced to 9.4 km (5.9 miles). During the surveys, marginal southwestern willow flycatcher habitat was observed interspersed with fair to good habitat. Marginal habitat consisted of: 1) areas of dry streambed (1.8 km or 1.1 miles in May), and 2) areas of little or no willow, salt cedar, or seep willow cover (9 km or 5.6 miles). Typically, the high water river channel was 15.2 to 27.4 m (50 to 90 ft) wide; the 3 to 6 m (10 to 20 ft) wide river meandered through this channel. In areas of marginal habitat, there was little or no shrubby cover near or next to the water. In some areas, clumps of cottonwood, seepwillow, and willow seedlings and small saplings were observed. These plants were typically 0.6 to 1.5 m high (2 to 5 ft). These areas may eventually become potential southwestern willow flycatcher habitat as the plants mature. Mature cottonwoods grew in rows along either side of the river in the terrace above the high water channel. An understory of scattered seepwillow, immature cottonwoods, salt cedar, and mesquite was typical under the cottonwood canopy. Widely scattered among this habitat type were small dense stands of willow, salt cedar, and seepwillow. These stands were considered potential habitat and the taped call of the southwestern willow flycatcher was played in these areas.

The remaining area surveyed along the San Pedro River (9.8 km or 6.0 miles) was fair to good potential habitat and was characterized by standing or flowing water and stands of willow, seepwillow, and other shrubs growing in patches along the river. This type of habitat started south of the confluence with Escapula Wash and extended north of the Charleston bridge.

1997 Survey - Results. Southwestern willow flycatchers were not detected along the 20.6 km (12.9 miles) of the San Pedro River surveyed by Fort Huachuca biologists. However, during the May survey within the SPRNCA, one singing southwestern willow flycatcher was recorded by BLM biologists near the Kingfisher Pond in the area of the San Pedro House (Whetstone 1997). During the June survey, a southwestern willow flycatcher was observed singing from the same area and, subsequently, a nest was found. This observation represents the first confirmed nesting of southwestern willow flycatchers in the SPRNCA since its inception. The nest was about 2.1 m (7 ft) high in a Gooddings willow and hung over the water. This nest was destroyed by an unknown cause and the willow flycatchers renested, this time about 1.5 m (5 ft) off the ground in a clump of seepwillow. There was a canopy of Fremont cottonwood and Goodding's willow 3 to 4.6 m (10 to 15 ft) over the seepwillow. The female was on eggs as of the third week of July. On 31 July, the nest had been abandoned and one dead cowbird young was in the nest (Krueper 1997).

The number of birds recorded along 12.9 to 16.2 km (6.3 to 7.6 miles) of the San Pedro River in the SPRNCA ranged from 691 during the May survey to 1025 during the June/July survey; a total of 63 species were recorded during these surveys (Table A.10-1). The yellow warbler (*Dendroica petechia)* was the most common species observed, accounting for 13 to 16 percent of the birds recorded during the three surveys. Other common species were the yellow-breasted chat, white-winged dove (*Zenaida asiatica*), Bewick's wren (*Thryomanes bewickii*), song sparrow, Abert's towhee (*Pipilo aberti)* vermilion flycatcher (*Pyrocephalus rubinus*), common yellowthroat, and gila woodpecker (*Melanerpes uropygialis*). The yellow warbler and yellow-breasted chat have been recorded as common breeding birds in other riparian areas in the southwest US including the SPRNCA (Krueper 1993). The importance of the river for more upland species was evident during these surveys. For example, 38 Gambel's quail (*Callipepla gambelii)* were recorded for the Fairbank to Boquillas Ranch ruins during the third survey of this route (Table A.10.1). In all cases, these birds were flushed from the widely scattered small pools of water that occurred along this route. Other wildlife frequently observed along the San Pedro River include the Coues white-tailed deer (*Odocoileus virginianus couesi*) and javelina (*Pecari tajacu)*.

Three state sensitive species were observed during these surveys; the black-crowned night heron (*Nycticorax nycticorax),* gray hawk (*Buteo nitidus),* and yellow-billed cuckoo (*Coccyzus americanus*). One adult black-crowned night heron was observed on June 30 at the south end of the survey area near a great blue heron (*Ardea herodias)* heronry. Single yellow-billed cuckoos were heard calling on 18 and 30 June also near the south end of the survey route. The gray hawk was recorded from numerous locations along the river during surveys along 20.6 km (12.8 miles) of the river plus an additional one day survey of a 5.1 km (3.2 miles) stretch of the river from the Route 82 Bridge north to Contention. It is estimated that this species occurred at 14 location along the 25.6 km (15.9 miles) surveyed. The distance between these locations ranged from 0.8 to 2.3 km (0.5 to 1.4 miles) and the average distance was 1.7 km (1.04 miles). Other birds of prey observed along the river were the red-tailed hawk (*Buteo jamaicensis),* Cooper's hawk (*Accipiter cooperii*), and great horned owl (*Bubo virginianus)*. All three species were recorded from three locations along the survey routes and all are assumed to be nesting species. A second great blue heronry was observed along the Contention to Summer survey route.

1997 Survey - Discussion. As indicated above, the elimination, alteration, and fragmentation of riparian habitat plus cowbird parasitism have been the principal reason for the decline of the southwestern willow flycatcher. Grazing has been a contributing factor in the decline of riparian habitat. Cattle have been excluded for the SPRNCA since 1987 and even though cattle and their sign were observed during the southwestern willow flycatcher surveys of the SPRNCA in 1997, their numbers are much less then the 9000 head of livestock that grazed the area before the establishment of the SPRNCA. As indicated above, the vegetation and breeding birds showed a positive response to the exclusion of cattle and at this time it is assumed that the effects of grazing are being reversed and the area is recovering from this land use. The SPRNCA is also protected from other human uses that could lead to the degradation of riparian habitat such as gravel operations, off-road vehicles, water diversion, and other activities.

Cowbirds were common along all areas surveyed during this study. Thirty to 45 cowbirds were counted during the three survey periods and this species accounted for about four percent of the total number of birds recorded. As indicated above, riparian areas surrounded by open habitat used for grazing such as occurs at the SPRNCA is good cowbird habitat. The contribution that Fort Huachuca is making to the local cowbird population from horses grazing at the Buffalo Corral appears to be negligible. Two cowbird surveys by SAIC personnel and six surveys by Jim Chase, who is a graduate student conducting research on the cowbird in the area, resulted in the observation of one cowbird at the Buffalo Corral which was likely a transient bird (Chase 1997; SAIC 1997) It is expected that cowbirds will continue to be a common species within the SPRNCA and there is a high potential for cowbird parasitism of the southwestern willow flycatcher as occurred in 1997.

The potential for ground water withdrawal by Fort Huachuca and Sierra Vista impacting the San Pedro River was discussed in sections 3 and 4 of this BA. In an analysis of vegetation growing in the riparian zone based on wetland indicator status (Reed 1988), Stromberg et al. (1996) found that wetland obligate herbaceous plant species such as sand spikerush hard-stem bulrush, and southern cattail declined sharply in abundance when depth to groundwater exceeded 0.25 m (0.8 ft); these species would disappear from the river if ground water levels declined uniformly by 1 m (3 ft). Fremont cottonwood and Goodding willow seedlings are the most sensitive woody species to ground water depth and these species survive only where depth to ground water is 1 m (3 ft) or less; seedlings of these species would disappear if there were a uniform reduction in ground water depth of 1m (3 ft) or more. The optimum depth of ground water for growth of mature Fremont Cottonwood, Gooddings willow, and seepwillow is 1 m (3 ft) or less. As ground water depth increases below 1 m (3 ft), these species will begin to show stress related responses and would likely disappear when ground water depth increases to 3 m (9 ft) or more (Stromberg et al. 1996). If ground water levels were to decline below 3 m (9 ft) over the long-term, the cottonwood/willow plant communities would disappear and species such as velvet mesquite and giant sacaton, which can survive in areas where the depth to ground water is 3 to 8 m (9 to 26 ft), would increase in abundance. Salt cedar may increase in areas of ground water levels of 1 to 3 m (3 to 9 ft) below the surface and cottonwoods and willows were beginning to disappear; this species does well at depths to groundwater less than 3m (9 ft). Salt cedar would not be expected to form dense stands in areas where depth to ground water is greater then 3 m (9 ft; Graf 1982).

Table B.10-1 Birds Recorded Along Four Survey Routes In The San Pedro River Riparian National Conservation Area During Three Surveys In May, June, And July, 1997 (1 of 2)

Species	Escapula wash north (2.1 km)[a]		Escapula wash south (2.1 km)			Fairbank to Boquillas Ranch Ruins (5.2 km)[b]			Contention to Summer (4.4 km)			Total[b]		
	S1[d]	S2[e]	S1	S2	S3[f]	S1	S2	S3	S1	S2	S3	S1	S2	S3
Yellow warbler	18	33	17	24	33	47	53	62	30	27	48	112	137	143
Yellow-breasted chat	10	17	9	12	19	30	39	45	16	25	33	65	93	97
White-winged dove	12	11	8	11	16	20	30	30	18	11	21	58	63	67
Bewick's wren	4	10	7	8	5	19	18	12	19	8	7	49	44	24
Song sparrow	3	11	10	12	21	22	38	18	13	17	16	48	78	55
Vermilion flycatcher	7	10	7	7	9	12	15	8	7	9	16	33	41	33
Brown-headed cowbird	5	13	6	14	12	11	14	14	8	4	17	30	45	43
Common yellowthroat	6	10	7	8	9	10	12	18	6	4	8	29	34	35
Gila woodpecker	3	7	5	9	11	9	22	23	12	6	13	29	44	47
Bell's vireo	4	7	3	7	5	8	6	9	11	8	16	26	28	30
House finch	3	2	4	5	6	8	7	4	9	9	7	24	23	17
Western wood pewee	3	2	4	2	4	3	7	8	9	6	11	19	17	23
Great blue heron	4	2	4	4	4	4	1	2	4	2	7	16	9	13
Abert's towhee	0	9	6	9	9	3	22	25	6	13	22	15	53	56
Summer tanager	2	14	2	5	7	5	9	9	3	8	12	12	36	28
Cassin's kingbird	0	7	2	9	13	4	17	26	6	11	18	12	44	57
Brown-crested flycatcher	0	5	1	5	6	3	11	5	8	7	7	12	28	18
Red-winged blackbird	3	3	8	6	5	0	0	0	0	0	0	11	9	5
Warbling vireo	1	1	4	1	0	2	0	0	2	0	0	9	2	0
Mallard	2	2	4	2	2	1	0	0	2	0	0	9	4	2
Northern cardinal	0	4	3	4	2	4	4	1	2	2	2	9	14	5
Gambel's quail	0	0	2	5	5	3	2	38[g]	4	4	6	9	11	49
Black phoebe	0	4	4	2	4	3	3	7	1	4	6	8	13	17
Northern rough-winged swallow	0	10	4	8	8	4	0	1	0	5	6	8	23	15

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Gray hawk	1	4	1	1	1	3	3	5	2	2	6	7	10	12
Northern flicker	0	0	0	1	1	3	3	2	2	1	4	5	5	7
Phainopepla	0	0	0	0	0	0	0	0	5	7	5	5	7	5
Chihuahuan raven	1	0	0	1	1	1	0	2	1	3	0	3	4	2
Killdeer	0	0	0	0	0	3	0	0	0	0	0	3	0	0
Western kingbird	2	0	0	0	2	0	0	0	0	0	0	2	0	2
Turkey vulture	1	4	0	7	3	0	0	3	1	5	0	2	16	6
Mourning dove	0	4	0	5	10	1	15	14	1	5	12	2	29	36
Red-tailed hawk	0	0	0	2	1	0	0	0	2	0	1	2	2	2
Bullock's oriole	0	0	0	5	1	0	3	0	2	4	7	2	12	8
Solitary vireo	1	0	0	0	0	0	0	0	0	0	0	1	0	0
Western flycatcher	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Western tanager	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Northern mockingbird	0	0	0	0	1	0	1	0	1	1	0	1	2	1
Lucy's warbler	0	1	0	0	0	0	1	1	1	0	1	1	2	2

Table B.10-1 Birds Recorded Along Four Survey Routes In The San Pedro River Riparian National Conservation Area During Three Surveys In May, June, And July, 1997 (2 of 2)

Species	Escapula wash north (2.1 km)[a]		Escapula wash south (2.1 km)			Fairbank to Boquillas Ranch Ruins (5.2 km)[b]			Contention to Summer (4.4 km)			Total[b]		
White-breasted nuthatch	0	2	0	3	7	0	2	4	1	0	6	1	7	17
Blue grosbeak	0	3	0	3	8	0	3	4	0	3	1	0	12	13
Lesser nighthawk	0	0	0	3	2	0	1	2	0	3	0	0	7	4
Lesser goldfinch	0	0	0	0	0	0	1	2	0	2	0	0	3	2
Canyon wren	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Curve-billed thrasher	0	0	0	1	0	0	0	0	0	0	0	0	1	0
Great horned owl	0	0	0	1	1	0	0	2	0	0	0	0	1	3
Hummingbird sp.	0	0	0	1	1	0	0	1	0	0	1	0	1	3
Yellow-billed cuckoo	0	0	0	1	1	0	0	0	0	0	0	0	1	1
House sparrow	0	0	0	1	2	0	0	0	0	0	0	0	1	2
Cliff swallow	N	N	0	0	0	0	N	7	0	0	0	0	N	7
Ladder-backed woodpecker	0	0	0	0	1	0	0	0	0	0	0	0	0	1

Cactus wren	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Black-crowned night heron	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Cooper's hawk	0	0	0	0	0	0	0	3	0	0	1	0	0	4
Say's phoebe	0	0	0	0	0	0	0	1	0	0	1	0	0	2
Black-throated sparrow	0	0	0	0	0	0	0	2	0	0	0	0	0	2
Common nighthawk[i]														
Greater roadrunner[i]														
Bridled titmouse[i]														
Bushtit[i]														
Vireo sp[i,j]														
Varied bunting[i]														
Total	96	214	13 2	21 5	26 0	24 8	36 3	42 0	21 5	22 6	34 5	69 1	101 7	102 5

[a] Breeding birds tallied along 2.1 km of the San Pedro River during survey 1 and 3.3 km during survey 2
[c] Breeding birds tallied along a total of 13.8 km of the San Pedro River during survey 1, 16.2 km during survey 2, and 12.1 km during survey 3
[d] S1 = Survey 1 which took place from 20 through 23 May, 1997
[e] S2 = Survey 2 which took place from 17 through 20 June, 1997
[f] S3 = Survey 3 which took place from 30 June through 3 July, 1997
[g] Most were quail obtaining water in the small pools of water that remained in this section of the river
[h] N = numerous
[i] Species observed in the SPRNCA but not recorded during breeding bird counts
[j] Song like red-eyed vireo but bird not observed to confirm species designation
[k] Breeding birds tallied along 5.2 km of the San Pedro River during survey 1 and 6.4 km during survey 2 and 3

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B.12 CACTUS FERRUGINOUS PYGMY-OWL

B.12.1 Description

The cactus ferruginous pygmy-owl, *Glaucidium brasilianum cactorum*, is the most northern subspecies of the ferruginous pygmy-owl, *G. brasilianum* (Lesh and Corman 1995) and is herein referred to as the pygmy-owl. The pygmy-owl is a small, secretive owl with a gray-red upper body, white underparts with red-brown streaks, a long rufous-colored tail with dark barring, yellow eyes, conspicuous black and white "eye spots" on the back of the head, and lacking eartufts (Lesh and Corman 1995; Proudfoot and Beasom 1996). Like many other birds of prey, *G. brasilianum* displays reversed sexual size dimorphism, with females slightly larger (75.1 gm or 1.7 lbs) than males (61.4 gm or 1.4 lbs; Earhart and Johnson 1970; Johnsgard 1988). The pygmy-owl can be distinguished from two other subspecies of *(G. brasilianum ridgwayi* and *G. brasilianum brasilianun*), by its grayer, lighter plumage, shorter wings, and longer tail (Lesh and Corman 1995).

B.12.2 General Ecology

G. brasilianum inhabits lowland riparian forests, forest edges, second growth forests, and thickets from sea level to 1,500 m (4,890 ft) in elevation with dense overall cover with high diversity of vertical structure (Enriquez-Rocha et al. 1993; Richardson 1997). In Texas, the pygmy-owl occupies mature, mixed oak-mesquite woodlands and is never found in open pastures, prairie habitats, or in low-growing oak mottes (Wauer et al. 1993). In Arizona, the pygmy-owl has adapted to Sonoran riparian deciduous woodlands, dense Sonoran desertscrub areas, and xeroriparian paloverde-mesquite-saguro habitat rather than the historical habitats of hydroriparian cottonwood-mesquite (Johnson-Duncan et al. 1988; Lesh and Corman 1995). Cavities for nesting and roosting may be an important component of pygmy-owl habitat. In Arizona, and in Sonoran desertscrub areas where these owls occur, saguaros may provide the majority of potential cavities (Lesh and Corman 1995).

The pygmy-owl is diurnal (Lesh and Corman 1995). Insects and reptiles compose the majority of the prey items, but anthropods, small birds, and small mammals are also preyed upon by the pygmy-owl (Lesh and Corman 1995). In addition, there are accounts of *G. brasilianum* attacking and killing prey larger than itself (i.e.; young domestic fowl, *Gallus gallus*, and captive guans, *Penelope*; Johnsgard 1988).

Pygmy-owls nest in cavities and breed in late winter to early spring (NWR 1997). In Arizona, pygmy-owls have been documented breeding in abandoned woodpecker cavities in cottonwood, palo verde, and mesquite trees (Gilman 1909; Bent 1938). Up to five eggs are laid in mid to late April and are incubated for approximately 22 to 28 days. The nestling period lasts approximately 30 days (Gilman 1909; Johnsgard 1988; Lesh and Corman 1995). Generally, male pygmy-owls display territorial and mate-attraction vocalizations more frequently from September through March (Lesh and Corman 1995). The pygmy-owl is non-migratory throughout its range (NWR 1997).

B.12.3 Status / Date of Listing

The pygmy-owl was designated an endangered species in Arizona by the USFWS on 10 March, effective 9 April 1997 (USFWS 1997e). Despite a recent lawsuit asking the USFWS designate critical habitat for this owl, the USFWS determined critical habitat was "not prudent" in Arizona (Ewutn 1997; USFWS 1997e). The USFWS justifies this action due to "overutilization for commercial, recreational, scientific, or educational uses" by birders (USFWS 1997e). In addition, the USFWS was concerned that if locations of pygmy-owls were published, this could lead to vandalism and disturbances (USFWS 1997e). Currently, a recovery plan has not been approved and critical habitat has not been designated for this owl. The pygmy-owl is also a USFS sensitive species, in Arizona it is a Wildlife Species of Concern , and proposed as a threatened species in Texas (Federal Register 14 April 1995, Vol. 60, No. 72).

B.12.4 Distribution and Abundance in the Region and at Fort Huachuca

This species was once "fairly numerous" in central and southern Arizona along the Gila, Salt, Verde, San Pedro, and Santa Cruz rivers and drainages (Gilman 1909; Lesh and Corman 1995). The San Pedro River basin is considered historical habitat even though it is at the edge of the elevational limit (Richardson 1997). The pygmy-owl ranges from southern Arizona and Texas to Michoacan, Nuevo Leon, and Tamaulipas in Mexico (Lesh and Corman 1995). In 1996, AGFD conducted surveys throughout Arizona and located nine breeding territories in northwest Tucson (AGFD 1996).

AGFD conducted early breeding surveys in 1997 and located 9 owls near Tucson in addition to two birds in Organ Pipe National Monument, New Mexico (Richardson 1997). While this is a decrease from the 12 birds located in 1996, surveys were terminated on 31 May 1997 because with the pygmy-owls new status, the necessary permits required for surveys to be conducted were not available Richardson 1997). All of the owls located in the Tucson area were found in Sonora desertshrub with fairly diverse structure (similar to studies by Lesh and Corman 1995) and nested in cavities of saguro cactus (Richardson 1997). This habitat type no longer occurs in the upper San Pedro River. The cactus ferruginous pygmy-owl is not known to occur on Fort Huachuca.

The pygmy owls decline is believed be due to a single factor; loss of riparian habitat (Lesh and Corman 1995). Urban and agricultural development, channelization, water diversion, groundwater pumping, livestock overgrazing, and timber harvesting account for the various causes of riparian habitat destruction (Lesh and Corman 1995).

Reintroductions of this species will not occur within Arizona until the pygmy-owl recovery plan is established and approved by the USFWS.

B.13 NORTHERN APLOMADO FALCON

B.13.1 Description

The northern aplomado falcon (*Falco femoralis septentrionalis*) is one of three aplomado falcon (*Falco femoralis*) subspecies. Unless otherwise stated, the term aplomado falcon or falcon in this report will refer to the northern subspecies *F.f. septentrionalis*, which is larger and paler than the aplomado subspecies of Central American and eastern South America (USFWS 1990d).

When perched, the aplomado falcon is easily distinguished by its distinct black and white facial pattern, long barred tail (dark with 8 white bars and white tip), dark "cummerbund", bluish-black beak, bright yellow legs and feet, black talons, and white trailing edge on the wings (Palmer 1988). In flight, the aplomado falcon has a longer tail, narrower wings, and shallower wingbeat than the peregrine falcon (*Falco peregrinus*) and the prairie falcon (*Falco mexicanus*; Palmer 1988). The aplomado falcons vocalizations is similar to the peregrine and prairie falcon, but with a higher pitch and more rapid call (Palmer 1988). Females are larger (407 gm or 0.9 lb) than males (260 gm or 0.6 lb; Palmer 1988). Juvenile aplomado falcons are more difficult to identify, but still have the facial patterns, tail coloration, and proportions of adults (Palmer 1988).

B.13.2 General Ecology

The aplomado falcon inhabits neotropical savannas and desert grasslands from southwestern US to Tierra del Fuego (Hector 1985). In the US, the northern aplomado falcon historically occupies yucca-covered sand ridges in coastal prairies, riparian woodlands in open grasslands, and scattered mesquite and yucca in desert grasslands (USFWS 1990d). Montoya et al. (1997) found that aplomado falcons in north-central Mexico occupied the few relict desert grasslands with dense ground cover of grasses interspersed with tall yuccas. In Arizona, the aplomado falcon has been reported in only two biotic communities; timbered riparian areas that meander through grasslands and open grasslands with scattered yucca (Corman 1992). According to the USFWS (1990d), suitable habitat should consist predominately of grasslands with scattered trees or shrubs and patches of plant communities that could provide nesting and feeding habitat. However, small bird abundance is probably the most important determinant of potential breeding habitat for this species (Hector 1985; USFWS 1990d). In addition, aplomado falcons use old stick nests of corvids and raptors as nesting platforms during the breeding season. Therefore, corvid and raptor density must be high enough (0.1 to .7 birds/ha) to ensure stick nests are available (USFWS 1990d).

The northern aplomado falcon diet consists of small birds, insects, rodents, and reptiles (USFWS 1990d). In similar studies of aplomado falcons (*Falco femoralis*) in eastern Mexico (Hector 1985), northcentral Chile (Jimenez 1993), and northcentral Mexico (Montoya et al. 1997) the falcons diet consisted primarily of birds such as doves, cuckoos, woodpeckers, blackbirds, flycatchers, and thrushes (USFWS 1990d).

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These falcons typically hunt by perching in a tree and chasing small birds in a horizontal flight pattern (USFWS 1990d). However, mated pairs will hunt cooperatively when chasing avian prey (Palmer 1988). These falcons will also glide or slowly flap in the air while hunting for insects (USFWS 1990d). Hunting typically occurs during the morning or late afternoon within 1 km (0.62 miles) of the nest (USFWS 1990d).

Little information is available on the reproductive behavior of northern aplomado falcons within the United States. Within eastern Mexico, the falcon breeds during the dry season of January through June (Palmer 1988). Because the breeding season is so long (181-242 days), northern aplomado falcons could potentially raise more than one brood per year (USFWS 1990d). Typically, the falcons use the of nests of corvids and raptors as platforms to lay 2 to 4 eggs (2.58 mean clutch size ; Palmer 1988). A study in north-central Mexico by Montoya et al. (1997) located 6 nests in yucca and 4 in honey mesquite (*Prosopis glandulosa*). Incubation lasts 31 to 32 days, nestlings fledge at 32 to 40 days, and the post-fledging period lasts approximately 4 weeks (USFWS 1990d). Siblings remain and hunt together for an extended period after independence (Palmer 1988).

Little information is available on the migratory behavior of this species. It is assumed this subspecies moves further south during the winter months, however, most northern aplomado falcons collected within the US were taken during the winter months (Palmer 1988).

B.13.3 Status / Date of Listing

In response to extirpation within the U S and declines in population numbers within eastern Mexico, the northern aplomado falcon was listed as a federally endangered species on 27 March 1986, but critical habitat has not been designated. The aplomado falcon recovery plan was established in 1990 with the goal of achieving 60 breeding pairs within the US (USFWS 1990d). Within Arizona it is a Wildlife Species of Concern.

B.13.4 Distribution and Abundance in the Region and at Fort Huachuca

Historically, the northern aplomado falcon was fairly common from southeastern Arizona and southwestern Texas through Guatemala and Nicaragua (Palmer 1988; USFWS 1990d). Most breeding records within the US occurred near Brownsville, Texas. However, there have been some reports of breeding in the Animas and Rio Mimbres Valleys and Jornada del Muerto of New Mexico and near Fort Huachuca, Arizona (Palmer 1988). While the northern aplomado falcon was still breeding within the US in 1952, it disappeared from most of its US range by 1940 (USFWS 1990d).

The northern aplomado falcon declined from various human-caused disturbances such as agricultural development, fire suppression, channelization of once permanent desert streams, recreational activities by humans, direct persecution by humans, and pesticide contamination (USFWS 1990d; Corman 1992; Ward and Ingraldi 1994). However, overgrazing by livestock appears to be the primary factor responsible for the decline of this falcon (Montoya et al. 1997). In addition, this species was exposed to contamination by (DDT) in the 1950s and 1960s due to its diet which consists primarily of avian prey and insects (Palmer 1988). Aplomado falcon eggs during this period had 25.4% thinner eggs than eggs prior to this period (Palmer 1988).

The USFWS 1990 aplomado falcon recovery plan recommended reintroducing this species to its historic range. This recovery plan proposed several potential release areas within Arizona including Fort Huachuca, Buenos Aires National Wildlife Refuge, Elgin Research Ranch, San Pedro Riparian National Conservation Area, San Simon Valley, Santa Rita Experimental Range, and the Willcox Playa Wildlife Area (USFWS 1990d).

In a 1992 AGFD evaluation of potential release sites in southeastern Arizona, a site on the San Pedro River near Hereford, approximately 12 km (8 miles) from Fort Huachuca, was ranked second of 10 potential reintroduction sites evaluated (Corman 1992). Rankings were based on relative density and diversity of potential prey species; habitat characteristics most closely resembling those of historical use by aplomados in Arizona; and vegetation structure unlikely to hinder the hunting success of released falcons. The San Pedro sites was characterized by a diversity of habitats, primarily consisting of semidesert grasslands and Sonora riparian deciduous forest.

Based on the AGFD evaluations in 1992, semidesert grassland and riparian communities on Fort Huachuca have a strong potential to support released or recolonizing aplomado falcons. The proximity of these habitat types on the East and South Ranges to abundant songbird populations in the SPRNCA suggests that foraging or nesting falcons may occur through much of these areas as aplomado falcon populations recover in the future. Presently, the northern aplomado falcon is not known to occur on Fort Huachuca and has been extirpated from Arizona (AGFD 1996).

Reintroduction of aplomado falcons in Texas by The Peregrine Fund, Inc. began in 1985 and continues today, with 104 falcons released through 1995 (TPF Fund 1994). In 1995, the first active aplomado falcon nest since 1941 was observed near Brownsville, Texas. This pair was captive-bred, released by the Peregrine Fund, and successfully fledged one young (TPF 1997). In 1994, the AGFD initiated a survey of appropriate release sites within southeastern Arizona (Ward and Siemens 1995). While no aplomado falcons were located during this survey, Ward and Siemens recommended further surveys be conducted to determine if natural colonization could occur or if falcons already exist in this area.

B.14 LESSER LONG-NOSED BAT

B.14.1 Description

The lesser long-nosed bat, *Leptonycteris curasoae yerbabuenae*, is a medium to large sized leaf-nosed bat of the family Phyllostomidae (Hoffmeister 1986). Phyllostomatidae, the New World leaf-nosed bats, is the third largest of the eighteen families of extant bats (Fenton 1992; Fleming 1988). Six subfamilies with approximately 49 genera and 140 species have been recognized in this highly diverse family (Fleming 1988; Nowak 1991). Among the subfamilies is the Glossophaginae or "tongue-feeding" bats of which *Leptonycteris curasoae* is a member. Bats in this subfamily are predominantly nectar feeders but, a range in variation in dietary specialization is exhibited, with pollen, fruits and insects taken to varying degrees (Howell 1974a).

Phyllostomids are generally considered to be tropical bats and occurrence within US boundaries of members of this family is an extreme northern extension and invariably, is in response to some particular floristic or physical habitat feature (Howell and Robinett 1995; Hoffmeister 1986; Bell et al. 1986). Three species of glossophagine bats are known to occur in the US; two of these occur in Arizona (Hoffmeister 1986). For each of these species, occurrence in the US is at the most northern extent of their ranges and in most cases, penetration beyond US borders represents seasonal northward shifts in the distributions.

Leptonycteris curasoae has short dense fur. The pelage, in adults, is a reddish brown, washed with brown or cinnamon ventrally (Nowak 1991). Juveniles are grayish (USFWS 1993a). Though appearing to be tailess, three caudal vertebrae are present. Adult weigh from 18 to 25 gm (0.63 to 0.88 oz) with a forearm length of 51 to 56 mm (2 to 2.2 in; USFWS 1993a). The name, *Leptonycteris*, is from the Greek *leptos* meaning slender and *nycteris* meaning bat. The reference is to the slender skull and rostrum characteristic of this genus (Hensley and Wilkins 1988). The elongate rostrum bears a small triangular noseleaf (USFWS 1993a; Nowak 1991). A long protrusable tongue with hooklike filiform papillae is present (Hoffmeister 1986).

B.14.2 General Ecology

The lesser long-nosed bat is generally a summer resident of Arizona found from desert grasslands and scrublands up to the edge of the oak woodlands in the mountains of southern Arizona. It occurs higher in the mountains in Mexico and the more southern portion of its range. During the day, these bats communally roost in mine tunnels and caves. At night, they forage in areas of saguaro, agave, ocotillo, palo verde and prickly pear (Hoffmeister 1986).

Suitable day roosts and concentrations of food plants are critical for lesser long-nosed bats. Macro- or microclimatalogical features determining suitability of day roost (beyond "caves and mines") have yet to be determined for this species (USFWS 1993b). Proximity to foraging areas appears not to be a factor. These bats appear to be able to commute over long distances to food sources and this has important consequences for habitat requirements and management. One population day roosts within caves on an island near Hermosillo, Mexico and flies over 25 km (15.5 miles) of open water to foraging in areas of organ pipe cactus on the mainland (Fenton 1992). Fecal analysis of male bats roosting in the Chiricahuas Mountains suggested foraging distances of 125 km (77.5 miles). These observations and others suggest

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that lesser long-nosed bats may have an effective foraging radius from roosts of 50 to 100 km (31 to 62 miles; USFWS 1993b). Destruction of food plants many kilometers from roosts may have a severe impact on colonies of this species. Despite our lack of understanding of roost requirements, it is clear that roosting lesser long-nosed bats are sensitive to human disturbance. This sensitivity is a major consideration for management programs and during survey work with this species. Alternate roosts may be critical to survival when human disturbance occurs. Interspecific disturbance by other bat species may also be a factor. Lesser long-nosed bats appear to avoid Patagonia Bat Cave, near Patagonia, Arizona, until after a large maternity colony of cave myotis abandons the site in late July (USFWS 1993b).

Distribution in Arizona appears to vary with sex are well as season. Female lesser long-nosed bats are already pregnant when they migrate northward in the spring into southern Arizona. They form large maternity colonies that consist of females only (Hoffmeister 1986), although recent evidence has shown that some adult males may be present (USFWS 1993b). Arrival time in Arizona is considered May but, pregnant females have been recorded from a cave 0.8 km (0.5 miles) south of Patagonia, Santa Cruz County (Patagonia Bat Cave), on April 8th and 10th and at hummingbird feeders in Tucson in January and February during recent years (USFWS 1993b; Hoffmeister 1986). A degree of roost philopatry (where they return to the same location each year) is demonstrated by females. Males are present primarily in the Chiricahua Mountains and generally arrive later in the state than females (USFWS 1993b). Young are born in Arizona from early May until late June. Despite the communal nature of maternity roosts, mothers appear to seek out their own young upon returning from foraging at night. The young are volant (capable of flying) at one month and will venture outside the roost by six to seven weeks (Hoffmeister 1986).

During their presence in Arizona, lesser long-nosed bats are primarily nectar and pollen feeders. They forage on the blossoms of paniculate agave, saguaro and organ pipe cactus (Hoffmeister 1986). These bats are important pollinators for several *Agave* species in the Sonoran desert and upland habitats (USFWS 1993b). Recent evidence has suggested that the degree of dietary specialization and dependence of primary food plants on the bats has been overstated. Cactus flowers and fruits as well as, *Agave* are now believed to form the core of this bat's diet in the US (USFWS 1993b). "Co-evolved" interdependence is more asymmetrical than once thought (Howell 1974b), with the bats more dependent on the plants for food than the plants are dependent on the bats for pollination and seed dispersal (USFWS 1993b). Exclosure experiments as well as, lack of coincidence of the distributions of bat and forage species distributions support this. Experimental bat exclosures has reduced the fruit set in several columnar plant species, however, a complete absence of fruit has not been observed (USFWS 1993b). Such experimental manipulations have not been conducted with paniculate agaves.

The selection of forage species varies seasonally with inter-species differences in blooming cycles. In Organ Pipe Cactus National Monument, Pima County, spring resident lesser long-nosed bats feed primarily on mass flowering saguaros. From June to late summer, they shift to organ pipe nectar. Late in the season agave are utilized (Howell 1980). Nectar consumed by these bats has a sugar content of nearly 20 percent. One panicle of agave blossoms will yield one-fourth to one-half cup of nectar (Hoffmeister 1986). During foraging for nectar, quantities of pollen accumulate on the face and body. Thus these bats serve an important role as pollinators. Additionally, the process of preening at digestion roosts transfers this pollen to the mouth. Pollen serves as an important source of amino acids for this bat (Howell 1974b). The feces of lesser long-nosed bats are like spatterings of bright yellow or orange paint and are very useful in identifying digestion roosts of this species (Hoffmeister 1986). Large colonies of lesser long-nosed bats require extensive stands of appropriate cacti and agave (USFWS 1993b).

During feeding bouts, bats may land on a panicle of blossoms and, inserting their nose into every blossom within reach, gradually work their way down the panicle. They may also hover in front of blossoms, as hummingbirds, and insert and withdraw their heads as they move among blossoms (Hoffmeister 1986). Bats also flock-forage, cooperatively gathering nectar to more efficiently feeding by reducing resampling of blossoms (Howell 1979). When sufficient nectar and pollen are not available, lesser long-nosed bats appear to supplementally feed on the pulp and seeds on the fruits of the saguaro and organ pipe cactus. Using their teeth, they will make a small feeding hole in the sweet ripe fruits (Hoffmeister 1986). Holes thus created will attract insects and provide foraging opportunities for insectivorous bat species (Howell 1980). At these times, seeds of the cactus fruits are ingested by lesser long-nosed bats and pass out through the feces, making these bats a seasonally important dispersing agent in desert ecosystems (Howell 1980).

Little is known about the population ecology of the lesser long-nosed bat. It is unclear if females bear a single young once a year or if multiple pregnancies occur. Copulation and parturition dates vary latitudinally, with tropical populations giving birth in December, those in the Cape of Baja California Sur in March and those in southern Arizona in May and later (USFWS 1993b). Birthing and lactation periods may be timed to coincide with peak flowering of forage plant species although parturition is not highly synchronous in any colony. Sex ratios at birth appear to be close to 1:1. Lesser long-nosed bats are unusual among phyllostomids in that they typically roost in very large colonies containing thousands to tens of thousands of individuals. Densities may reach greater than 50 bats per square foot (USFWS 1993b). Data suggest that dense clusters of bats impart a metabolic savings to individuals through reduced thermoregulatory costs (Howell 1979). This characteristic gregarious behavior has lead to the destruction of large numbers of lesser long-nosed bats in Mexico deliberately by humans who believed the bats to be a vampire species (Nowak 1991). Small colonies can also occur.

Longevity and natural sources of mortality have not been studied. If longevity patterns are similar to other phyllostomid, lesser long-nosed bats likely live as long as ten years (Fleming 1988). Predators include snakes within roosts, carnivores at the entrances of roosts and owls at foraging areas.

B.14.3 Status / Date of Listing

The lesser long-nosed bat was listed as endangered on 22 September, 1988. A status report by D. E. Wilson and other surveys conducted during the 1980s, suggested that bat numbers had fallen from the tens of thousands to near 500 individuals or fewer (USFWS 1993b; Federal Register 1988). T.H. Fleming contends that the species is more abundant than surveys conducted prior to listing indicated. Sources of error in these surveys include selection of survey caves, shifts in local density, difficulty in obtaining accurate counts for this species and timing of surveys (USFWS 1993b). The species was found to be in jeopardy because of disturbance of roost sites, loss of food sources (paniculate agave), and direct killing by humans. Subsequent work and review have indicated that despite this bats' sensitivity, historical disturbance to roosts, and fragility of its foraging habitat, listing may have been unwarranted based upon Fleming's work (USFWS 1993b). In Arizona this bat is a Wildlife Species of Concern.

B.14.4 Distribution and Abundance in the Region and at Fort Huachuca

Within the US, the distribution of *Leptonycteris curasoae* is from near Phoenix (Picacho Mountains) in the north and the Agua Dulce Mountains in the west and then southward and southeastward to the Chiricahua Mountains and into extreme southwestern New Mexico (USFWS 1993b; Hoffmeister 1986; Hoffmeister 1957). In the southwestern US, the lesser long-nosed bats roosts are known to occur in six counties in southern Arizona and one in New Mexico. The type specimen (*Leptonycteris nivalis sanborni* Hoffmeister = *Leptonycteris curasoae yerbabuenae*) is from the mouth of Miller Canyon, Huachuca Mountains, 16.1 km (10 miles) south southeast of Fort Huachuca, Cochise County, Arizona (NMDGF 1996; Hoffmeister 1986; Hoffmeister 1957).

Five maternity colonies are known in the U.S. These are Bluebird Mine, Copper Mountain Mine, Hilltop Mine, Old Mammon Mine and Patagonia Bat Cave, all in Arizona (USFWS 1993b). Roosts fluctuate in size and composition throughout the year. Current evidence indicates that tens of thousands of lesser long-nosed bats roost and or feed in Arizona seasonally. Until mid-July, Arizona lesser long-nosed bats are concentrated in three main maternity roosts southwest of Tucson, Bluebird Mine, Copper Mountain Mine and Old Mammon Mine. The Copper Mountain Mine is the largest colony with about 20,000 adult females. The other two mines support approximately 4000 bats. The Copper Mountain Mine colony was the subject of a study of the impacts of low level military aircraft; results indicated no relevant changes in several subjectively scored and remotely monitored behaviors (Dalton and Dalton 1993). Bats from Mexican caves likely enter Arizona each evening in the tens of thousands to feed. Because of their high mobility, the number of lesser long-nosed bats within feeding range of southwestern Arizona is in excess of 150,000 (USFWS 1993b). After mid-July, females and young begin disbursing from maternity roosts and numbers in caves such as the Patagonia Bat Cave begin to increase as a result. Coinciding with this movement, bats are increasingly reported appearing at hummingbird feeders. Fluctuations in total numbers and sex ratios occur at this time in most occupied day roosts. Numbers in these other day roost caves may approach 30,000 (Sidner 1996). The fall migration southward is completed by mid-September but, some bats remain, visiting hummingbird feeders well into October.

Fort Huachuca is located within a portion of this species' range utilized as a migratory corridor during the southward seasonal movement. Semidesert grasslands and lower oak woodlands provide summer and early fall foraging habitat of paniculate agave. There are no records of parturant or lactating lesser long-nosed bats from the installation. Rather, occurrence coincides with post-maternity disbursal of juveniles and adult females. Feeding and mass gain is critical at this time for survival during migration (Sidner 1996). Prior to listing, little work was done on Fort Huachuca resulting in a paucity of historical occurrence data. Recent work, beginning in 1989 and continuing through 1997, resulted in the discovery and consistent monitoring of numerous day roosts, digestion roosts and potential roosts. Monitored sites include Manila Mine, Pyeatt Cave, Upper Pyeatt Cave, Indecision Cave and Wren Bridge (Sidner 1997). Manila Mine and Wren Bridge are important digestion roosts for varying numbers of lesser long-nosed bats. Manila Mine and Pyeatt Cave have been found to be used as night roosts. One observation has been made away from roosts.

Sidner (1997) observed fluctuations in lesser long-nosed bat roost populations during monitoring efforts. In 1990-1992, the number of lesser long-nosed bats was less than 200. The number of bats peaked to 1,400 in 1993 and then declined to approximately 500-600 bats in 1994 and 1995. Peak counts at Manila Mine decreased from 610 in 1996 to 93 in 1997. This mine was also used less often as a day roost than in 1996 (Sidner 1997). However, day roost activity at Pyeatt Cave increased from one lesser long-nosed bat from 1990—1996 to 38 and 44 bats observed in 1997. This variation may be due to the flowering pattern of *Agave palmeri*. Nectar feeding activity at A. palmeri plants by lesser long-nosed bats on the fort was drastically reduced in 1997 compared with 1996 (Sidner 1997).

The paniculate agave, *Agave palmeri* has been the focus of a comprehensive management plan at Fort Huachuca (Howell and Robinett 1995). This species thrives in gravel and cobble covered red clay soils associated with hilly slopes and dissected alluvial fans. It is infrequently found on valley floors. Blossoms are considered nocturnal and produced during mid-summer at the instillation. The importance of this forage plant species for the lesser long-nosed bat has been previously stated. Because of a regional history of poor management and fire related habitat destruction, the *Agave palmeri* stands at Fort Huachuca represent one of the better foraging areas for glossophagine bats. Nectar feeding bats, while present in the area depend these agave stands for their sustenance during late summer and agave protection is seen as critical for bat survival (Howell and Robinett 1995). In response to this need, efforts have been made to protect major agave stands at the instillation. Stands are protected from fire, direct or indirect mechanical disturbance and soil structure damage (Howell and Robinett 1995).

B.15 JAGUAR

B.15.1 Description

The jaguar (*Felis onca*) is the largest endemic cat in the western hemisphere, measuring 170 to 240 cm (6 to 8 ft) in length. Adult male jaguars average 90 to 120 kg (198 to 265 lbs, rarely exceeding 135 kg or 300 lbs) while adult females average 60 to 90 kg (132 to 199 lbs; Nowak 1991). This large, muscular cat is occasionally melanistic in color (black) in its southern range, but typically appear to be tawny-yellow in color, profusely speckled with black spots. These black spots may form broken circles or rosettes with one or more black spots in the center (Hoffmeister 1986). In addition, a row of black elongated black spots merge into a solid line along the midline of the back (Nowak 1991). The tail of jaguars are typically 40 to 45 percent of the head-body length (Hoffmeister 1986).

B.15.2 General Ecology

Jaguars use a wide variety of habitats. In the arid southwest toward middle latitudes they show an affinity for lowland wet habitats. Generally they prefer warmer, tropical climates associated with water and are rarely found in extensively arid regions (Hoffmeister 1986; USFWS 1997c). Jaguars inhabit dense chaparral and timbered portions of their range. The den is typically located in a rocky cave or in dense, thorny thickets (Davis 1974).

A population of 30 to 50 jaguar require a minimum 2,007 to 3,016 square km (772 to 1,160 square miles). Individual jaguars use 26 to 52 square km (10 to 20 square miles), depending upon the available prey base (Hoffmeister 1986). The jaguar preys on more than 85 species, including javelina (*Pecari tajacu*), capybaras, armadillos (*Dasypus*), deer (*Odocoileus*) and various fish and birds (USFWS 1997c). Along the US / Mexico border, deer and javelina are its primary prey base. The dietary overlap between the jaguar and the mountain lion (*Felis concolor*) is about 70 percent, however, jaguars consume larger prey (Hoffmeister 1986; Johnson and Van Pelt 1997). Unlike most felids which kill with a throat or neck bite, the jaguar kills its prey by biting through the temporal bones of the skull (Cyber Zoo 1997).

Jaguars breed year round (Cyber Zoo 1997). However, in the more northern regions of its range, there is evidence of a spring breeding season (USFWS 1997c). The female provides all parenting to the 1 to 4 cubs born after a 95 to 105 day gestation period. The cubs are weaned at 3 months of age but remain in the birthing den for up to 6 months and associate with the mother for up to 24 months (Cyber Zoo 1997). In the wild, few jaguars life greater than 11 years (USFWS 1997c).

B.15.3 Status / Date of Listing

In March 1997, the AGFD released a Conservation Assessment and Strategy (Johnson and Van Pelt 1997) for the jaguar in Arizona and New Mexico along with a Memorandum of Agreement (AGFD 1997e) to unite 17 agencies in order to identify and assess the risks and to promote the expansion of the jaguar. The commitment of these agencies was instrumental in finalizing listing: the jaguar was extended endangered status within the US on 22 July 1997, effective 21 August 1997 (USFWS 1997c). With this ruling, the jaguar is now listed as endangered within the US, Mexico, and South America (USFWS 1997c). In addition, the jaguar is a Wildlife Species of Concern in the state of Arizona. Critical habitat was found to "not be prudent" and therefore was not designated (USFWS 1997c). A more extensive recovery plan (than USFWS 1990c) will probably be established for this cat (USFWS 1997c).

B.15.4 Distribution and Abundance in the Region and at Fort Huachuca

Historically, this species range extended from a Argentina north into Louisiana, Texas, New Mexico, Arizona, and possibly southern California (Johnson and Van Pelt 1997; USFWS 1997c). There may have been a resident population in southwestern Arizona (USFWS 1997c). The current range of the jaguar has been reduced to more southern areas of central Mexico, central America, and northern Argentina (USFWS 1997c). In areas of Mexico such as the arid Sierra del Bacatete, jaguars are common and are still hunted (Hoffmeister 1986). Since 1848, there have only been 84 recorded jaguar occurrences in Arizona; most were assumed to be transients (Johnson and Van Pelt 1997). Currently, there is no known resident populations of jaguars in the US (USFWS 1997c). In Arizona, transient jaguars are occasionally observed; in 1996, two sightings occurred in Pima County and in Cochise County, both documented by photographs. These observations may be evidence that the jaguar is becoming more abundant within its historical range. However, because jaguars use a wide variety of habitat types and regional jaguar sightings are rare, the probability of jaguars occurring within Fort Huachuca is low.

The primary threats to the jaguar population are habitat fragmentation and poaching. A minimum of 64 jaguars have been killed within Arizona since 1900 (USFWS 1997c). An illegally poached jaguar pelt can sell for as much as $8,000.

B.16 OCELOT

B.16.1 Description

The ocelot (*Felis paralis* [or *Leopardus paralis*]) is a medium sized cat weighing 7 to 16 kg (15 to 35 lbs) and 122 cm (48 in) in total length. The dark-ringed tail of the ocelot is about one half the length of the head-body (Nowak 1991). The coat is creamy gray to yellow-red in color with black streaks and stripes running horizontally down the body (Hoffmeister 1986). In addition, there are two black stripes on each cheek and one to two black transverse bars on the inside of each leg (Nowak 1991).

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B.16.2 General Ecology

In tropical America, the ocelot is found more often in forested habitats (Hoffmeister 1986; Davis 1974; USFWS 1980a). However, in Texas and Arizona (the northern part of their range), the ocelot usually inhabits dense, chaparral thickets or shrubby vegetation along streams. A study conducted in Texas by Tewes (1982) revealed ocelots occur in habitats with very dense brush. In that study, brush canopy cover was a better indicator of potential habitat than the brush species composition and canopy coverage of habitat known to contain ocelots was typically greater than 99% (Tewes 1982). The Tewes study utilized a 95% canopy coverage to identify optimal habitat where a contiguous dense brush stand of 40 ha (100 acres) or two proximate 30 ha (75 acre) stands were located. Tewes considered several small acres of typical brush to be good habitat if they totaled a minimum of 40 ha (100 acres) and were in close proximity to one another with brush between patches as a corridor. Narrow, riparian strips were also considered good corridors, however they have minimal value if not within a larger patch network.

Ocelots are generally crepuscular and nocturnal, spending the day within heavy brush areas (USFWS 1990c). They typically hunt alone and prey primarily on small mammals and birds but will occasionally consume snakes, lizard, insects, and fish (USFWS 1990c). Males typically have larger home ranges than females, with a single male's home range overlapping more than one female's home range (USFWS 1990c).

Mating can occur throughout the year and captive females are polyestrous year round (USFWS 1990c). After a 70 to 89 day gestation, 1 to 4 (typically 1 or 2) kittens are born in a secluded den typically found in a dense thicket or fallen tree (USFWS 1990c). At 8 weeks of age the kittens join the mother on foraging excursions and by 4 months of age reach independence. However, they may remain within the mother's home range for up to 2 years of age (USFWS 1990c; Cyber Zoo 1997). Sexual maturity can be reached by 8 months of age, but 2 years is the usual age of first conception (USFWS 1990c) .

B.16.3 Status / Date of Listing

The ocelot is listed as federally endangered and a recovery plan has been approved (USFWS 1990c). In addition, this species is listed as sensitive by the USFS and endangered in Mexico. Formerly considered endangered in Arizona, this species is now considered a Wildlife Species of Concern (AGFD 1996). No critical habitat has been designated for this cat.

B.16.4 Status and Abundance in the Region and at Fort Huachuca

The ocelot ranges from northern Argentina to the extreme southern portions of Arizona and Texas (Hoffmeister 1986, USFWS 1990c). The last confirmed ocelot observation in Arizona was in 1964 in the Huachuca Mountains (Girmendonk 1994). Since 1966, there have been three reliable reports of ocelots greater than 483 km (300 miles) south of Fort Huachuca in Sonora, Mexico. In addition, there have been unconfirmed and unreliable ocelot sightings since 1980: two from the San Pedro Valley; one from the Holbrook-Concho area; and one from the Sasabe area (USFWS 1990c). Because ocelots are rare and sightings within the area are unconfirmed, the occurrence of ocelots on Fort Huachuca is unlikely. In addition, potential habitat is limited to approximately TBD ha (acres) of mesquite woodland vegetation along the Babocomari and San Pedro Rivers, but the density of the vegetation in these areas may be too low to support ocelots (Tewes 1997).

Poaching and fur trade in the mid 1800s is thought to be the major cause for the decline of the ocelot (Cyber Zoo 1997). The USFWS (1990c) ocelot recovery plan recommends implementing hunter and trapper surveys to obtain information on current ocelot distribution within Arizona. When a sighting is reported, the recovery plan recommends trained biologist respond in a timely manner to obtain sighting information and to determine the reliability of the sighting.

B.17 JAGUARUNDI

B.17.1 Description

The jagurundi (*Felis yagouaroundi* [or *Herpalurus yagouaroundi*]) is a small to medium sized cat, weighing 5 to 11 kg (12 to 24 lbs) and 115 cm (45 in) in length. This cat has a smooth, unspotted coat, gray to red-yellow in color. The head is small with round, shortened ears and brown eyes. The jagurundi can be distinguished from the ocelot by its monocolor rather than the presence of dark streaks on the sides and back (Hoffmeister 1986). This cat is said to occasionally resemble a weasel or otter in appearance (Nowak 1991).

B.17.2 General Ecology

Similar to the ocelot in its habitat requirements, the jaguarundi prefers dense vegetation for shelter (USFWS 1990c), including thorny thickets where cacti, mesquite, and other spine-studded vegetation occurs (Davis 1974). These cats are most often seen on the ground, however they are expert climbers and often obtain food while in trees (Davis 1974). The jaguarundi appears to prefer habitat in close proximity to water (USFWS 1980b). The jaguarundi is primarily active at night, however it is often be seen during the day near water sources (Davis 1974).

Jaguarundi have a 63 to 70 day gestation period. Two to four kittens are born with dark spots that disappear after 3 months of age (NMDGF 1996).

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B.17.3 Status / Date of Listing

The jaguarundi is a federally listed endangered species with an approved recovery plan. In addition the USFS lists this cat as a sensitive species. Arizona has no protection status and critical habitat has not been identified for this cat.

B.17.4 Distribution and Abundance in the Region and at Fort Huachuca

The jaguarundi range is from the southern regions of Texas through Central America into South America. No jaguarundi specimens have been collected in Arizona, however there have been 11 reliable, unconfirmed sightings of jaguarundi within the state. Seven of these sightings were within Cochise County; six from the Chiricahua Mountains (105 km or 64 miles from Fort Huachuca) and one sighting near Dragoon Mountain (48.3 km or 30 miles northeast of Fort Huachuca; USFWS 1990c). Although limited potential habitat for the jaguarundi exists in the mesquite woodlands along the Babocomari and San Pedro Rivers, it is unlikely that the jaguarundi occurs on Fort Huachuca. Fort Hucahuca is northeast of the confirmed range of the jaguarundi.

B.18 MEXICAN GRAY WOLF

B.18.1 Description

The Mexican gray wolf (*Canis lupus baileyi*) is the smallest and the southernmost subspecies of the gray wolf (*Canis lupus*) in North America (Bednarz 1988). Adult Mexican wolves weigh from 27 to 41 kg (60 to 90 lbs) and are 134 to 198 cm (53 to 78 in) in length (The Phoenix Zoo 1996). Males are typically larger than females in this species. Mexican wolves are reddish-gray in color with black on the face, sides, and back; reddish between the ears and underside of belly; with white on the throat and foreleg area; and a distinct white lip line around the mouth (Sevilleta LTER 1996).

B.18.2 General Ecology

The Mexican wolf historically occupied oak woodlands, pine/oak woodlands, or pine forests with adjacent grasslands of mountainous terrain, dense cover, and accessible water (Bednarz 1988). Historic observations of this species in New Mexico indicate that they were primarily found in the upper Sonoran and transition zones associated with densely forested terrain composed of ponderosa pine (*Pinus ponderosa*), pinyon pine (*Pinus edulis*), and oak (*Quercus* spp.). The Mexican wolf tends to avoid desert habitats, although they have been known to cross the desert floor to suitable habitat (Bednarz 1988, Hoffmeister 1986; Groebner et al. 1995). According to McBride (1980), while it appears wolves prefer certain vegetative associations, their presence or absence is generally a response to prey availability.

The primary prey item of the Mexican wolf is mule and white-tailed deer, but their diet also includes elk, javelina and occasionally pronghorn, bighorn sheep, rabbits, hares, turkeys and small rodents (USFWS 1995c; The Phoenix Zoo 1996). It is estimated that a Mexican wolf consumes 2.8 kg (6.1 lbs) of meat a day compared to the northern subspecies that consumes 4.1 kg (9.0 lbs) per wolf per day (USFWS 1995c). The heavy livestock depredation by Mexican wolves in the late 1800s and early 1900s may have been due to new settlers who greatly reduced the natural prey base through over-hunting and habitat degradation (USFWS 1995c). If adequate, natural prey populations exist, the Mexican wolf should coexist with livestock in a similar manner as wolves in the northern Rocky Mountain regions. No accounts exist of Mexican wolves attacking humans (USFWS 1995c).

The Mexican wolf typically breeds in February, producing 5 to 6 pups after a 63 gestation period (USFWS 1995c). The entire pack of 2 to 8 individuals (typically 5) provide food for the pups after they are weaned at 5 to 6 weeks of age (The Phoenix Zoo 1996). In the wild, Mexican wolves reach sexual maturity at 2 years of age and live 8 to 16 years (USFWS 1995c).

B.18.3 Status / Date of Listing

The Mexican gray wolf was listed as a federally endangered species in 1976 and a federal recovery plan was approved in 1982 (AZA 1995). Critical habitat will not be designated for the experimental, non-essential population of this canid. In Arizona this wolf is considered a Wildlife Species of Concern.

B.18.4 Distribution and Abundance in the Region and at Fort Huachuca

Historically, the Mexican wolf inhabited areas from southern Arizona (including the Huachuca Mountains) and Texas down to southern Mexico (Groebner and Johnson 1995). Currently, the Mexican wolf is believed to be extirpated from the US (Sevilleta LTER 1996). Despite numerous reports of sightings in Arizona, New Mexico, Chihuahua, and Durango, Mexico by the public, survey efforts by the AGFD failed to detect any evidence of the Mexican wolf in either Arizona or the northern reaches of Sonora, Mexico (Groebner and Johnson 1995; The Phoenix Zoo 1996.

Because of the broad habitat requirements of the Mexican gray wolf, most of the upland habitats of Fort Huachuca may be suitable for wolves. There have been no recent wolf reports from Fort Huachuca; however, several unconfirmed reports have come from the Parker Canyon Lake region south of the fort (USFWS 1995c). Much mixed woodland, montane conifer forest, and savanna communities on the South and West Ranges may support the species and potential prey base (Coue's white-tailed deer, desert mule deer, javelina, and pronghorn) if it recovers in the future, either naturally or through reintroductions (USFWS 1995c). The USFWS (1995c), predicted that if natural recolonization was to occur on Fort Huachuca, it would not pose a conflict with the fort's activities nor with the regional economy.

A portion of the population's decline has been attributed to the increase of agriculture and roads in their habitats, as well as a decrease in the deer population from human hunting. However, the dominant cause of the Mexican wolf's extirpation in Arizona was persecution by humans (USFWS 1995c). Federal wolf eradication efforts were begun in 1915 and by 1930, very few Mexican wolves remained (USFWS 1995c).

The USFWS proposed reintroducing this endangered species within its historic range in the southwestern US (AZA 1995). The proposed release sites were in the Blue Range Primitive Area of east-central Arizona and the White Sands Missle Range of southcentral New Mexico (USFWS 1995c). In March 1997, Secretary of Interior Bruce Babbit approved Alternative A for reintroductions of the Mexican wolf. This alternative classifies the wolf as an experimental, non-essential population and does not allow for dispersal outside of a 18,200 sq km (7000 sq mile) recovery area. Beginning in spring 1998, three wolf family groups will be released into the Blue Range Primitive Area for 3 to 5 years until a 100 wolf population objective is achieved (Parsons 1997). Suitable habitat for this species does exist on the South Range of Fort Huachuca and it is possible that introduced wolves could relocate to those habitats. However, per Alternative A, dispersing wolves will be relocated if they move out of the recovery area surrounding the Blue Range Primitive Area (Parsons 1997).

B.19 SONORA TIGER SALAMANDER

B.19.1 Description

The Sonora tiger salamander (*Ambystoma tigrinum stebbinsi*) is a large, stocky salamander with a dark vent and light colored bars or spots on a dark background (USFWS 1997a). The snout and vent lengths vary from 6.7 to 12.5 cm (2.6 to 4.9 in; USFWS 1997a). The snout is broad and round, eyes are small, and there are tuberacles on the underside of the front and hind feet (Stebbins 1985). The larval form are aquatic and are uniform dark in color with plume-like gills and developed tail fins.

It is believed that the Sonora tiger salamander is a hybrid of *A. t. mavartium* and *A. t. nebulosum*. However, based on the apparent geographic isolation and analysis of mitochondrial DNA, a subspecific designation is warranted (USFWS 1997a).

B.19.2 General Ecology

The habitat requirements for the genus include lakes, ponds, and stock tanks in the desert grassland areas of southern Arizona with surrounding vegetation types ranging from arid sagebrush plains and rolling grassland to mountain meadows and forests with elevations of near sea level to 3660 m (12,000 ft). Jones et al. (1988) found the Sonora tiger salamander only in stock tanks and believe that these salamanders in Arizona disperse only in stock tanks moved via humans.

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The Sonora tiger salamander feeds on worms, mollusks, arthropods, fish, amphibians and small mammals (AGFD 1997c).

The larvae of this salamander hatch in the spring and metamorphose into terrestrial salamanders by late July to early August (USFWS 1997a). However, only 17 to 40 percent metamorphose annually while the remaining larvae mature into branchiates (sexually mature salamanders that remain in the breeding pond and appear aquatic and larval-like) or over-winter as larvae (USFWS 1997a).

B.19.3 Status / Date of Listing

The Sonora tiger salamander is listed as federally endangered (USFWS 1997a). No critical habitat was designated for this species and a recovery plan has not yet been approved (USFWS 1997a). Arizona considers this amphibian a Wildlife Species of Concern

B.19.4 Distribution and Abundance in the Region and at Fort Huachuca

Historically, the salamander inhabited springs, natural cienegas, and backwater pools prior to human settlement (USFWS 1997a). However to date, all confirmed historical and extant aquatic populations of the Sonora tiger salamander have been found in cattle tanks or impounded cienegas (USFWS 1997a). Currently, this species is located in south-central Arizona in Santa Cruz and Cochise Counties, Arizona. Populations are known to exist in the Copper and Scotia Canyons of the Huachuca Mountains (approximately 1,000 m (3,280 ft) and 5,000 m (16,400 ft) from Fort Huachuca respectively), Parker Canyon, and the Patagonia Mountains. The only known population occurring on Fort Huachuca inhabits an artificial stock tank in upper Garden Canyon (Wallace 1998). However, a drought in 1996 severely diminished the volume of water in the tank, and surveys in 1996 detected only a single branchiate salamander (Stone 1996). Stock tanks and springs in the South Range and the reservoirs located in the southwestern corner of the East Range of Fort Huachuca represent potential habitat for this salamander. However, surveys conducted from 1994 through 1997 by AGFD have not located any salamanders in these areas (Wallace 1998).

In spring 1997, four Sonoran tiger salamanders were collected from a pond in the upper Garden Canyon by researchers at Arizona State University in order to conduct genetic studies on this subspecies (Synder 1997). Results of this research are not currently available.

It is estimated that up to 90 percent of the riparian habitat along Arizona's major watercourses has been lost or degraded (USFWS 1997a). The Sonora tiger salamander population has decreased significantly since the 1950s, and a variety of factors have likely influenced their decline (USFWS 1997a). The most serious threat has been disease and predation by introduced nonnative fishes, crayfish, and bullfrogs (*Rana catesbeiana*). Additionally, anglers have used the salamander as a fishing bait. Smaller populations are vulnerable to reduced fitness resulting from inbreeding and random extirpation from habitat destruction. Finally, habitat destruction and degradation resulting from livestock overgrazing, water diversions, dredging, and groundwater pumping pose serious threats to the continued success of extant populations of this salamander (USFWS 1997a).

AGFD (1996) has made several management recommendations for improving the current status and distribution of the Sonoran tiger salamander, they include: removing non-native fishes and bullfrogs from known and potential breeding sites; establishing breeding populations in renovated ponds; enhancing the breeding and larval habitat through partial fencing of population in renovated ponds; determine causes and management solutions to diseases; and mitigate additional impacts to salamander populations.

B.20 RAMSEY CANYON LEOPARD FROG

B.20.1 Description

Platz (1993) was the first to describe a new, distinct species of frog, the Ramsey Canyon leopard frog (*Rana subaquavocalis*). Previously, it was thought only one species of leopard frog (*Rana pipiens*) existed. Recent evaluations of behavior and genetic analyses have resulted in the description of six species in the genus *Rana* in the US, including the Ramsey Canyon leopard frog (Platz 1993).

The Ramsey Canyon leopard frog is a large frog that is typically green and spotted. It also has cream-colored spots on the caudal portion of the dark thigh. This species is distinguished by its call which is given underwater.

B.20.2 General Ecology

The Ramsey Canyon leopard frog ranges in elevation of 1,645 to 1,737 m (5,400 to 5,700 ft) only within the Huachuca Mountains. It inhabits stock ponds and natural or plunge pools that are 30.5 to 131.1 cm (1.0 to 4.3 ft) deep. The plant communities surrounding these sites are typically oak woodland or semidesert grassland.

The Ramsey Canyon leopard frog feeds primarily on arthropods and other invertebrates, and on small vertebrates as well (AGFD 1995). In addition, it is known to exhibit lekking behavior (a courting behavior where the males gather at the center of a pond and vocalize to attract females) during the breeding season (ESWR 1996).

B.20.3 Status / Date of Listing

The Ramsey Canyon leopard frog was recently removed as a candidate for federal listing but is on Arizona's list of Wildlife Species of Concern.

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B.20.4 Distribution and Abundance in the Region and at Fort Huachuca

The Ramsey Canyon leopard frog is limited to artificial ponds in Brown, Ramsey, Miller and Tinker canyons within a 6 km (3.7 miles) radius on the east slope of the Huachuca Mountains near Fort Huachuca (AGFD 1995). The Tinker Canyon population on Fort Hucahcua appears to be doing well and is reproducing (Wallace 1998). In addition, this amphibian was introduced into the Lower Garden Canyon pond in September 1996. The Garden Canyon pond population does not appear to be doing well due to limited water and despite efforts to control exotic bullfrogs and mosquitofish (Hessil 1997). Surveys conducted in from 1994 thorugh 1997by AGFD did not find any additional populations of the Ramsey Canyon leopard frog outside of Tinker pond (Wallace 1998). Ramsey Canyon leopard frogs were to be released in 1997 at a newly constructed pond at the confluence of Tinker and Brown Canyons Stone 1996). However, this pond has not yet been constructed, thought contruction is planned for 1998 (Hessil 1998). The reservoirs located on the East Range of Fort Huachuca are outside the published elevation range for this species, but may provide potential habitat for this frog.

The primary threats to Ramsey Canyon leopard frog are population fragmentation, low population sizes, and habitat loss due to water diversion and groundwater pumping (AGFD 1996). In addition, adequate water flows, pond depth, oxygen levels, pH levels, and reduction of predation by crayfish, bullfrogs, and non-native fishes are thought to be critical to the species preservation. The most studied population (the Ramsey Canyon Preserve) has had low recruitment in recent years.

The Ramsey canyon leopard frog declined from 96 frogs in 1990 to 26 frogs in 1995 (ESWR 1996). Therefore, the AGFD, the USFWS, the USFS, the BLM, the Nature Conservancy, Coronado National Forest, The US Army Intelligence Center, Fort Huachuca, and private landowners have developed a 5 year conservation agreement for the Ramsey canyon leopard frog on 16 July 1996 (SAIC 1996). This agreement was implemented in order to reduce threats to the species, stabilize the species population, and maintain its habitat (SAIC 1996).

B.21 CHIRICAHUA LEOPARD FROG

B.21.1 Description

The Chiricahua leopard frog (*Rana chiricahuensis*) is a distinct species, formerly considered *Rana pipens* (Platz and Mecham 1979). The Chirachua leopard frog is a relatively stocky frog with cream colored spots on the dark, caudal portion of the thighs. This frog has dorsolateral folds (on the top and sides) that are interrupted and deflected medially (toward the middle). This frog is distinguished from other *Rana sp.* by it vocalization that is given out of water (Platz and Mecham 1979).

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B.21.2 General Ecology

This species is highly aquatic and will utilize a variety of water sources such as rocky streams with deep rock bound pools, river overflow ponds, oxbows, permanent springs, earthen stock tanks and ponds. This species appears to require permanent or nearly permanent water sources. There is evidence to support that Chiricahua leopard frog larvae will adapt morphologically (change shape and color) to various habitats for camouflage (Jennings and Scott 1993). Vegetation surrounding populations is usually oak and mixed oak/pine woodlands, but will occasionally be found in chaparral, grasslands, and even desert. In southeastern Arizona, the elevation range of known populations is 372 to 1,226 m (1,219 to 4,023 ft). Adults feed on arthropods and other invertebrates, while larvae eat algae, organic debris, plant tissue and minute organisms in the water (AGFD 1997d).

B.21.3 Status / Date of Listing

The Chiricahua leopard frog is a candidate for federal listing. Within Arizona, this frog is a Wildlife Species of Concern.

B.21.4 Distribution and Abundance in the Region and at Fort Huachuca

The Chiricahua leopard frog has two separate ranges: the montane portions of the Mogollon Rim extending into New Mexico; and the southeast montane regions of Arizona and adjacent Sonora, Mexico (Platz and Mecham 1979). Potential habitat exists on the South and West Ranges for this frog. However, this frog was not located on Fort Huachuca during surveys conducted by AGFD in 1996. The reservoirs located on the East Range of Fort Huachuca are outside the published elevation range of this species, but may provide future potential habitat.

The Chiricahua leopard frog is declining in Arizona, and it is suspected that introduced bullfrogs and fish are to blame (AGFD 1997d). While there are no management strategies in place, this frog is currently being studied by the AGFD and research has been conducted by area universities.

B.22 YAQUI CHUB

B.22.1 Description

The Yaqui chub, *Gila purpurea,* is a darkly colored, medium sized (less than 16 cm or 6 in) minnow with a wider head and anterior than the posterior portion of the body (USFWS 1994). The dorsal, anal, and pelvic fins of this fish typically have 8 fin-rays and a vertically elongated, triangle-shaped caudal spot is typically present (USFWS 1994). During the breeding season, males have a bluish sheen over their bodies and the females turn a yellow-light brown color.

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B.22.2 General Ecology

Yaqui chub are found in deep pools, scoured areas of cienegas, and undercut banks of calm permanent streams (USFWS 1994). This species appears to seek the cover of undercut banks and debris during the daytime (USFWS 1994). Little is known about the biology of this species. However, in designating critical habitat for three fish species, including the Yaqui chub, the USFWS (1984a) determined that clean, small, permanent streams and spring pools free of exotic fishes were necessary. The service recommended streams with deep pool areas separated by riffles and flowing areas with moderate current should provide adequate habitat for this fish.

The Yaqui chub feeds primarily on algae, insects, and detrital materials (USFWS 1994). Spawning typically occurs in the spring. This species is ideal for reintroduction because it has high reproductive potential; a few adults can quickly produce a large population of rapidly maturing young (USFWS 1994).

B.22.3 Status / Date of Listing

The Yaqui chub was listed as an federally endangered species in 1984. This species is also listed as a USFS sensitive species. In Arizona this fish is a Wildlife Species of Special Concern. The USFWS has designated all aquatic habitat in the San Bernardino NWR as critical habitat and a recovery plan has been approved for this fish (USFWS 1984a).

B.22.4 Distribution and Abundance in the Region and at Fort Huachuca

The Yaqui chub, both historically and currently, is distributed in the US within the San Bernardino / Leslie Canyon NRW, the House Pond on Slaughter Ranch Historical Site, and the West Turkey Creek in the Chiricahua Mountains. Within Mexico, this species historically and currently is found with perennial reaches of Rio San Bernardino (USFWS 1994). This fish did not historically, nor presently, occur within the San Pedro River and Fort Huachuca area (Young 1997).

The Yaqui chub was extirpated from Arizona as a result of habitat degradation from arroyo cutting, water diversion, impoundment construction, development of canal systems for irrigated agriculture, and excessive pumping of underground aquifers (USFWS 1984a). Populations were reestablished in Leslie Canyon in the Swisshelm Mountains in 1967, within the San Bernardino NWR in 1979, and in a ponds on Turkey Creek in 1986 (NMDGF 1996). Existing populations are imperiled by habitat modification, competition, and genetic swamping due to releases of closely related exotic species, such as the red shiner (*Cyprinella lutrensis*) and channel catfish (*Ictalurus punctatus*; USFWS 1984a).

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B.23 YAQUI CATFISH

B.23.1 Description

The Yaqui catfish, *Ictalurus pricei*, is a streamlined, slender fish with a caudal fin that is shallowly forked and an anal fin with a broadly rounded distal margin (USFWS 1994). The body of this fish is very speckled when young and becomes more unicolored gray with age. The barbels of the Yaqui catfish are black except on the chin area where they are gray to white in color (USFWS 1994). The Yaqui catfish can easily be confused with the channel and blue catfishes which have a more deeply forked caudal fin and a longer anal fin-base (USFWS 1994).

B.23.2 General Ecology

Yaqui catfish are known to occur in large rivers in areas of medium to slow current with gravel/sand substrates (USFWS 1994). Little else is known about the biology of this species; however, in designating critical habitat for three fish species, including the Yaqui catfish, the USFWS determined that clean, small, permanent streams and spring pools free of exotic fishes were necessary. The service recommended streams with deep pool areas separated by riffles and flowing areas with moderate current will provide adequate habitat for this fish . Overgrown, cut banks and accumulations of detritus may be necessary for feeding and shelter (USFWS 1984).

B.23.3 Status / Date of Listing

The Yaqui catfish was listed as a federally threatened species in 1984. This species is also listed as a USFS sensitive species. The USFWS has designated all aquatic habitat in the San Bernardino NWR as critical habitat and a recovery plan has been approved for this fish (USFWS 1984a). In Arizona this fish is a Wildlife Species of Special Concern.

B.23.4 Distribution and Abundance in the Region and at Fort Huachuca

The Yaqui catfish was endemic to the Rio Yaqui and Casa Grandes basins and south through the Rio Fuerte system, but is believed to have occurred only in San Bernardino Creek in the US (USFWS 1994; NMDGF 1996). In 1899, Yaqui catfish were stocked into the upper Santa Cruz River of Arizona, however, this population persisted only into the 1950s (USFWS 1994). Today no populations of Yaqui catfish exist in Arizona. This fish did not historically, nor presently, occur within the San Pedro River and Fort Huachuca area (Young 1997).

Yaqui catfish were extirpated from Arizona as a result of habitat degradation from arroyo cutting, water diversion, impoundment construction, development of canal systems for irrigated agriculture, and excessive pumping of underground aquifers (USFWS 1984a). Existing populations of Yaqui catfish within the San Yaqui basin are imperiled by habitat modification and by competition and genetic swamping due to releases of exotic species such as the red shiner and channel catfish (USFWS 1994). The Yaqui catfish recovery plan (USFWS 1994) recommends reintroducing this species into parts of the Mimbres River watershed in Mexico, east of Fort Huachuca.

B.24 GILA TOPMINNOW AND YAQUI TOPMINNOW

The following discussion refers to two subspecies of the topminnow genus, *Poeciliopsis*. The northern subspecies (*Poeciliopsis occidentalis occidentalis*) is commonly referred to as the Gila topminnow, while the southern subspecies (*Poeciliopsis occidentalis sonoriensis*) is commonly referred to as the Yaqui topminnow. For the purposes of clarity, use of the term Gila topminnow in this discussion refers to the northern subspecies, Yaqui topminnow to the southern subspecies, while the term topminnow will be used to refer to both subspecies in general.

B.24.1 Description

The topminnow is a small sexually dimorphic, guppy-like fish. Males reach a length of approximately 25 mm (1 in) and the larger females reach a length of 30 to 45 mm (1.2 to 1.8 in; NMDGF 1996). Coloration is tan to oliveaceous with a whitish yellow belly. Females have a dark band on each side while breeding males turn black with some golden/yellow fins. A dark spot occurs at the base of the dorsal fin, and the body has some dark edgings or speckling (NMDGF 1996). The Gila topminnow has a shorter snout, with a subsuperior (lower portion is larger) mouth, and a dark lateral line from the opercle to the base of the caudal fin on the females. The Yaqui topminnow has a longer snout, a superior mouth, and the lateral line on females rarely exceeds the pelvic fins (USFWS 1983).

B.24.2 General Ecology

The topminnow inhabits springs, marshes, permanent streams, intermittent streams, and ciengas at elevation below 1500 m (4920 ft; USFWS 1983). This species prefers areas with dense mattings of algae, debris, and emergent or aquatic vegetation (USFWS 1983). True to its name, the topminnow tends to congregate in shallower waters or near the surface of deeper waters in areas of moderate current, below riffles, and along the margins (NMDGF 1996). The topminnow is omnivorous, foraging on organic detritus, algae and other plants, and invertebrates such as crustaceans, insects, and mosquito larvae (NMDGF 1996).

During reproduction, males vigorous pursue females and frequent copulations occur. Once sperm has been transferred, females are capable of storing it for their entire lives, thus eliminating the need for additional copulation. Sperm is transferred internally, and the topminnow gives birth to live young (viviparous); as many as 15 at one time. In waters that do not freeze in winter, this species is capable of reproducing throughout the year, and young can reach sexual maturity as early as six weeks of age. In areas of seasonal variation, breeding season generally occurs during the spring and summer, but even in these areas the topminnow is restricted to areas that do not freeze.

B.24.3 Status / Date of Listing

The Gila topminnow and the Yaqui topminnow were listed as federally endangered species in 1967. Both species are listed as a USFS sensitive species. The USFWS has not designated critical habitat for either subspecies. A comprehensive recovery plan has been prepared by USFWS with the goal of removing both the Gila topminnow and Yaqui topminnow from the federal list of endangered species by restoring them as secure, stable, self-sustaining, and separate subspecies throughout a significant portion of their historic range (SAIC 1996). In Arizona these fish are Wildlife Species of Concern.

B.24.4 Distribution and Abundance in the Region and at Fort Huachuca

In Arizona, populations of the Gila topminnow were once common and abundant in both the Gila River basin and the Rio Yaqui basin, but today persist only in a small number of spring systems. Historically, populations of the Yaqui topminnow occurred only in the Rio Yaqui drainage, but are now restricted solely to the San Bernardino National Wildlife Refuge within this drainage (NMDGF 1996). An additional population was introduced and has continued to survive in Leslie Canyon in the Swisshelm Mountains (NMDGF 1996).

Outside of Arizona, where a severe decline of both the northern and southern subspecies has occurred, populations of the Yaqui topminnow have remained largely intact, while those of the Gila topminnow have decreased significantly over time. The demise of both subspecies is attributed to habitat destruction and competition with and predation by the non-native mosquitofish (*Gambusia affinis*; NMDGF 1996).

Reintroductions of the Gila topminnow in Arizona have been successful in restoring populations and establishing new ones in some areas (NMDGF 1996). Since the 1967s, 180 reintroductions of the Gila topminnow have occurred throughout its historic range (AGFD 1996). Thirty-seven of these reintroductions have occurred on Fort Huachuca, Aravaipa Creek, and Babocomari Creek; all of these reintroduced population have since disappeared (SFB 1996a). However, the Gila topminnow now occurs in 11 indigenous localities in southern Arizona (AGFD 1996). All but a few populations are considered to be in danger of extirpation (SFB 1996a).

The Yaqui topminnow may be re-established in the San Bernardino and Leslie Canyon NWR in the future (AGFD 1996).

B.25 BEAUTIFUL SHINER

B.25.1 Description

The beautiful shiner, *Cyprinella formosa mearnsi,* also known as the Yaqui shiner, is a compact (6.4 cm or 2.5 in), shiny minnow with a pointed snout and oblique mouth (USFWS 1994). This fish has 8 to 9 anal fin-rays and 8 dorsal and pelvic fin-rays. During the breeding season, males become quite colorful with yellow-orange on the caudal and lower fins, a dark dorsal fin, a bluish body, and a red-orange head (NMDGF 1996). During the non-breeding season this fish has a tan body with a lighter belly color (USFWS 1994).

B.25.2 General Ecology

The beautiful shiner is a mid-water-column species that remains near, but not within, plants and cover along the margins of ponds (USFWS 1994). In Mexico, this species is also found on riffles, intermittent pools, and small streams (USFWS 1994). Little else is known about the biology of this species, however, in designating critical habitat for this fish species, the USFWS determined that clean, small, permanent streams and spring pools free of exotic fishes were necessary. The USFWS (1984a) suggests streams with deep pool areas separated by riffles and flowing areas with a moderate current and overgrown, cut banks with accumulations of detritus as habitat necessary for feeding and shelter.

B.25.3 Status / Date of Listing

The beautiful shiner was listed as a federally threatened species in 1984. This species is also listed as a USFS sensitive species and has no state protection status in Arizona. The beautiful shiner has been recognized by Arizona as a subspecies. The USFWS has designated as critical habitat all aquatic habitat in the San Bernardino NWR and a recovery plan has been approved for this fish (USFWS 1984a).

B.25.4 Distribution and Abundance in the Region and at Fort Huachuca

Historically, the beautiful shiner occurred in the United States only within the San Bernardino Valley and the Mimbres River of New Mexico (USFWS 1994). Today, this fish has been virtually extirpated from the US. At the time of listing, the beautiful shiner was known to occur in the US only within the San Bernardino NWR.

The beautiful shiner was fairly common within Arizona prior to 1968, however, natural populations have not been located within the state since 1970 (NMDGF 1996). This species was extirpated from Arizona as a result of habitat degradation from arroyo cutting, water diversion, impoundment construction, development of canal systems for irrigated agriculture, and excessive pumping of underground aquifers and from predation by non-native fishes (USFWS 1984a; NMDGF 1996). Existing populations are

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imperiled by habitat modification and by competition and genetic swamping due to releases of closely related exotic species such as the red shiner and channel catfish (USFWS 1984a). This fish did not historically, nor presently, occur within the San Pedro River and Fort Huachuca area (Young 1997).

The beautiful shiner was reintroduced into the San Bernardino NWR in 1990 (NMDGF 1996). This population appear to be reproducing well within three ponds on the refuge (USFWS 1994). The USFWS's recovery plan (1994) for this species calls for reintroducing the beautiful shiner within its historical range once appropriate areas have been identified for reintroduction.

B.26 DESERT PUPFISH

B.26.1 Description

The desert pupfish, *Cyprinodon macularius*, is a small cyprinodontid (50 mm or 2 in) with a compact body and a rounded dorsal profile (USFWS 1993a). Female and juvenile pupfish are silver in color with dark, with vertical bars on each side, colorless fins except for a dark ocellus on the dorsal and occasionally anal fin. Males are larger and during the breeding season and are an iridescent light-blue color with bright orange caudal dorsal and caudal peduncle fins (USFWS 1993a).

B.26.2 General Ecology

Pupfish were first described in the literature in 1853 from collections taken from the San Pedro River. The pupfish has since been the subject of considerable study because of its remarkable ability to survive under conditions of high water temperatures (38° C or 100° F), low dissolved oxygen concentrations, high salinity, and abrupt changes in salinity and temperature (USFWS 1993a). The desert pupfish typically occupy cienagas, springs, small streams, and the edges of larger bodies of water with shallow, clear water and soft substrates (USFWS 1993a).

Desert pupfish are opportunistic, diurnal omnivores, that eat a wide variety of food items such as detritus, algae, ostracods, copepods, insects, worms, and mollusks (USFWS 1993a). Young, larval pupfish appear to consume tiny invertebrates and become more opportunistic with age.

Desert pupfish may become sexually mature at six weeks of age under ideal conditions, however, most do not begin to breed until their second summer (USFWS 1993a). Male pupfish actively defend territories during the breeding season while awaiting a female to chose their site for spawning. Young pupfish growth is dependent upon age, habitat and environmental conditions, and population density (USFWS 1993a). The life span of desert pupfish in the wild varies from one to three years of age.

B.26.3 Status / Date of Listing

The desert pupfish was listed as a federally endangered species in 1995. This species is also listed as a USFS sensitive species and endangered in Mexico. A federal recovery plan was approved in 1993. Critical habitat was designated at Quitobaquito Springs, in Pima County, Arizona (SFB 1996a). In Arizona this fish is a Wildlife Species of Special Concern.

B.26.4 Distribution and Abundance in the Region and at Fort Huachuca

Despite its hardy nature, the pupfish has suffered severe population decline. Historically, the desert pupfish was once common, but not continuous, below 1,500 m (5,000 ft) in southern Arizona, southeastern California, New Mexico, and Mexico (USFWS 1993a). In Arizona, the desert pupfish was once found within the Gila River basin, and probably in lower Colorado, Agua Fria, Hassayampa, and Verde Rivers (USFWS 1993a).

Only one indigenous population of desert pupfish exists in Arizona at the Quitobaquito Spring (SFB 1996a). Reintroduction endeavors have been made in a number of locations throughout Arizona, including three unsuccessful reintroductions on Fort Huachuca: at Boston Water Cachement and Kino Springs in 1982, and Buffalo Corral Spring in 1988 (SFB 1996a). No reintroduction efforts have been made within the San Pedro River due to lack of suitable habitat and exotic fish predators (SFB 1996a).

Reasons for decline in pupfish numbers include groundwater pumping, dewatering of springs, stream impoundment, channelization, livestock grazing, timber harvest, mining, road construction, pesticide application, and interactions with non-native species (USFWS 1993a). Exotic fishes, such as the western mosquitofish, sailfin molly (*Poecilia latipinna*), largemouth bass (*Micropterus salmoides*), and juvenile ciclids (*Oreochromis* ssp. and *Tilapia* spp.) pose the greatest threat to extant desert pupfish populations (USFWS 1993a). In addition, non-native bullfrogs (*Rana catebeiana*) may also prove to a serious management concern for future reintroduction efforts. In Arizona, these future reintroduction endeavors will be located within the Gila, Hassayampa, Agua Frio, San Pedro, Santa Cruz, Salt, and Verde River drainages (USFWS 1993a).

B.27 LOACH MINNOW

B.27.1 Description

The loach minnow, *Rhinichthys cobitis,* is another member of the minnow family *Cyprinidae*. The loach minnow is an elongated (approximately 60 mm or 2.4 in), ventrally flattened fish that may be identified by its lower lip; thick and creased in such a way as to appear lobed when viewed laterally (NMDGF 1996). Distinctive creamy-white spots are located anterior and posterior to the dorsal fin and near the caudal peduncle. During the breeding season, males are bright reddish-orange in coloration, while the females become yellowish on their fins and lower body (USFWS 1990b).

B.27.2 General Ecology

The loach minnow is a small fish inhabiting shallow areas of rapidly flowing, turbulent streams with moderate to high gradients at elevations below approximately 2,200 m (7,000 ft; USFWS 1990b). A reduced gas bladder has allowed the loach minnow to become a highly specialized bottom-dwelling fish (USFWS 1990b). This species inhabits areas of elevated cobble and rubble substrates with rocks and crevices, generally located along stream margins or in eddying currents at the heads of riffles (AGFD 1996).

Loach minnows are opportunistic, benthic insectivores (USFWS 1990b). Adult loach minnows feed primarily on riffle-dwelling larval of ephemeropterans, dipterans, and larvae and pupae of plecopterans and trichopterans. Chironomids are an important food base for the less opportunistic juvenile loach minnows (USFWS 1990b). Foraging occurs mostly along stream bottoms rather than in the stream drift.

The loach minnow reaches sexual maturity at one year of age. The spawning season varies with geography, but populations in Aravaipa Creek typically spawn in late winter or early spring (USFWS 1990b). Spawning occurs in the same areas in which these fish inhabit throughout the year. Fertilized eggs mature along the underside of rocks along the stream bottom. At hatching, larvae are generally 5 mm (0.2 in) long. By the end of the first summer, the young fish reach a length of approximately 30 to 40 mm (1.2 to 1.6 in). Little growth occurs during the winter months, but by the end of the second growing season, the adults reach full length. The average life span of a loach minnow is between 15 to 24 months (USFWS 1990b).

B.27.3 Status And Date Of Listing

The loach minnow was listed as a threatened species on 28 October 1986. The USFWS prepared a recovery plan for protection and restoration of the loach minnow with the objectives of protection of existing populations, restoration of populations in portions of historic habitat, and eventual delisting (USFWS 1990b). Critical habitat was designated for the species in both New Mexico and Arizona in 1994. In Arizona, part of the designated critical habitat consists of Aravaipa Creek, a tributary of the San Pedro River that enters the mainstream about 100 km (62 miles) north of Fort Huachuca. In Arizona this fish is a Wildlife Species of Special Concern.

B.27.4 Distribution and Abundance in the Region and at Fort Huachuca

The loach minnow is native to the Gila River basin of New Mexico, Arizona, and Sonora, Mexico (USFWS 1990b). In Arizona, loach minnow were known to occur in the Salt River, White River, East Fork White

River, Verde River, Gila River, Aravaipa Creek, San Francisco River, Blue River, Eagle Creek, the San Pedro River, and other major tributaries of large streams (Minckley 1973). Estimation of historical abundance of loach minnow in these streams is difficult due to substantial data gaps in the historical record, but researchers believe suitable and occupied habitat was once widespread throughout the region (USFWS 1990b). According to the USFWS (1990b), species abundance was local and depended heavily on environmental conditions.

Today, extant populations of loach minnow are present only in a few river systems in Arizona, including the North Fork of the White River, Aravaipa Creek, the East Fork of the North Fork of the Black River, Eagle Creek, San Francisco River, Blue River, and Campbell Blue Creek (AGFD 1996). The loach minnow is considered rare in most of these streams, and is common only in Aravaipa Creek and the Blue River drainage. It is possible that unknown populations may still exist in unsurveyed stretches of river systems within portions of Mexico, and on some Indian Reservation and National Forest lands (USFWS 1990b). The loach minnow does not appear to be present within the Fort Huachuca area (Young 1997). However, the USFWS's recovery plan for the loach minnow (1990b) recommends reintroducing this species within its historical range, including perennial reaches of the San Pedro River, Babocomari River, and Eagle Creek.

Decline of the loach minnow is attributed mostly to human activity and, to a lesser degree, to the introduction of non-native fish species. Human activities, such as groundwater pumping, stream channelization, water diversion, damming, livestock grazing, poor timber harvest practices, mining, agriculture, and development have all contributed to the decline of loach minnow populations (NMDGF 1996). Such activities have resulted in a number of devastating downstream effects including dewatering, thermal and chemical changes, elimination of food sources, increased suspended sediment and turbidity, changes in runoff patterns, and many others, which ultimately contribute to the decline of fish populations (NMDGF 1996).

B.28 SPIKEDACE

B.28.1 Description

The spikedace, *Meda fulgida,* belongs to the monotypic genus *Meda*, and is a member of the minnow family Cyprinidae. This small, sleek fish is distinguished by the second dorsal ray which fits into a groove on the first dorsal ray, giving it the appearance of a spine (NMDGF 1996). The sides are metallic silver in color, flecked dorsally with brown or black splotches over an olive or brownish background and the abdomen is yellowish white. Males exhibit a brassy color on their head and fins during breeding season, while females retain their silver coloring year-round (NMDGF 1996). Adults reach a length of approximately 63 to 75 mm (2.5 to 3 in; USFWS 1990a).

B.28.2 General Ecology

Spikedace typically occupy shallow main channel areas of flowing waters over sand and gravel substrates (NMDGF 1996), but habitat has been reported to vary with age, geography, and time of year (USFWS 1990a). Juveniles inhabit quiet pools with soft, fine-grained bottoms along the stream periphery. In winter months, adults move toward stream margins where they inhabit cobble-bottomed areas.

Spikedace are carnivorous, feeding mostly on small (2 to 5 mm or 0.08 to 0.2 in long), terrestrial, and aquatic insects suspended in the stream and occasionally on the larvae of other fish species (USFWS 1990a). Spikedace are dependent on streams with erratic flows and periodic spates that scour the sands and gravel substrates over which they forage (NMDGF 1996).

Spikedace spawn between mid-March and June. Groups of males gather in spawning areas consisting of shallow riffles over sand and gravel bottoms. Breeding is initiated in response to combinations of stream discharge and water temperature (USFWS 1990a). In seeking receptive females, males do not display territoriality or other forms of aggressive behavior toward each other. Once a female has chosen a male's area, the male swims alongside the female and both adults deposit their gametes into the water on or near the stream bottom, where the fertilized eggs mature (USFWS 1990a).

Although growth patterns vary with geography, juvenile spikedace generally grow rapidly in the summer and fall and obtain standard adult length by November. Very little growth occurs in winter months. Life span is typically one to two years, although some adults may reach the age of three and, very rarely, four years of age (USFWS 1990a).

B.28.3 Status / Date of Listing

The spikedace was listed as a threatened species on 01 July 1986 by the USFWS. In 1990, the USFWS prepared a federal recovery plan with the objectives of protecting existing populations, restoring populations in portions of historic habitat, and eventually delisting the species (USFWS 1990a). Critical habitat for the spikedace was designated in both New Mexico and Arizona in 1994. In Arizona, part of the critical habitat consists of Aravaipa Creek, a tributary of the San Pedro River that enters the mainstream about 100 km (63 miles) north of Fort Huachuca Military Reservation. No critical habitat was designated along the San Pedro River mainstream (SFB 1996a). In Arizona this fish is a Wildlife Species of Special Concern.

B.28.4 Distribution and Abundance in the Region and at Fort Huachuca

Historically, the spikedace is endemic to the Gila River basin of New Mexico, Arizona, and Sonora, Mexico below 1828m (6000 ft; SFB 1996). In Arizona, this species was once widespread (occupied up to 2575 km or 1600 miles of streams) throughout the larger river systems including the Gila, Salt, Verde, San

Francisco, and San Pedro River systems (AGFD 1996; SFB 1996a). Reports of spikedace in the San Pedro River exist from as early as 1846 up through the 1950's and 1960's (SFB 1996a). Little information regarding historic abundance of this species is available, but researchers presume that the spikedace was once common and abundant throughout its range (USFWS 1990a). However, abundance at any one site was extremely variable from year to year (AGFD 1996).

Today, populations of the spikedace are limited to less than 190 km (118 miles) of streams in Eagle Creek, the upper Verde River, and Aravaipa Creek in Arizona; and the Gila River in New Mexico (AGFD 1996; SFB 1996a). The Aravaipa Creek population is the only extant population in the San Pedro River basin (NMDGF 1996). This fish has otherwise been extirpated from the mainstream of the San Pedro River and its tributaries (SFB 1996a). Population decline is attributed to the combined effects of habitat destruction and/or modification and introduction of non-native fish species. Activities contributing to habitat loss include alteration of natural flow regimes, livestock grazing, mining, agriculture, timber harvest, and other developments. Introduction of non-native fishes has resulted in increased predation upon the spikedace and increased competition with other fishes, particularly the red shiner for suitable habitat (USFWS 1990a; SFB 1996a).

Currently, the spikedace does not occur within the Fort Huachuca area. However, this species historically occupied the mainstream of the San Pedro River, 30 km (19 miles) east of Fort Huachuca. The U. S. Fish and Wildlife Service's recovery plan proposes reintroducing the spikedace within its historical range. The San Pedro River system in Arizona, including the Babocomari River, north of Fort Huachuca, represent the most amenable historical areas in which to reestablish the spikedace (USFWS 1990a).

B.29 RAZORBACK SUCKER

B.29.1 Description

The razorback sucker, *Xyrauchen texanum*, is one of the largest suckers in North America, weighing up to 6.5 kg (14 lbs) and 1 m (38 in) length (SFB 1996). These fish have a dark head and keel, are oliveaceous in color on the back, brown-red on the sides, yellow-white on the underside, with a dark dorsal fin, and a yellow anal fin (NMDGF 1996). Female razorback suckers have smaller tubercles on the anal and caudal fins. Breeding males have a bright yellow abdomen and large conical breeding tubercles on the anal and caudal fins (NMDGF 1996).

B.29.2 General Ecology

The razorback sucker is a long-lived fish that inhabits large rivers, backwaters, and reservoirs with strong currents, deep pools, and eddies approximately 2.0 m (6.6 ft) deep (NMDGF 1996). This fish prefers temperature ranges of 22.9 to 24.8° C (70 to 75° F) and appears to prefer gravel bottoms. The razorback sucker is benthic level omnivore. This species diet consists primarily of algae, dipteran larvae, and occasionally plant debris; *Ephemerptera* ssp. and *Trichoptera* ssp. (NMDGF 1996).

In razorback suckers spawn from late winter to early summer. Fertilized eggs mature and hatch along stream bottoms. In this species, several males attend each female, no nest is built, and no parental care is given to the 75,000 to 144,000 eggs laid. Therefore, mortality for young larvae and juvenile razorback suckers is very high, due to predation from introduced species (NMDGF 1996). Sexual maturity is reached at four years of age with adults living 40 years or more.

B.29.3 Status / Date of Listing

The razorback sucker was listed as federally endangered in 1991. In addition, this species is listed as a sensitive species by the USFS. In 1994, the USFWS designated critical habitat for this fish that included 15 reaches of the Colorado river as well as portions of the Gila River (above the confluence with the San Pedro River), Salt River, and Verde River. A recovery plan has not been prepared for the razorback sucker. In Arizona this fish is a Wildlife Species of Concern.

B.30 Distribution and Abundance in the Region and at Fort Huachuca

Razorback suckers were once abundant and widely distributed in the rivers of the Colorado and Gila River Basins (AGFD 1996; SFB 1996a). However, there are few published accounts of this fish within the San Pedro River (SFB 1996a). Today, the razorback sucker appears to have disappeared from the Gila River Basin (SFB 1996a). The populations of razorback suckers that do remain are in the Colorado River lower basin (between the Grand Canyon and the border with Mexico) and are small, with very little recruitment. The largest extant population exists at Lake Mohave, Arizona-Nevada, but this population has not shown recruitment for many years (NMDGF 1996). In 1981, large-scale reintroductions began in the Gila, Verde, and Salt Rivers, but the long-term success of these populations is not known (NMDGF 1996). No reintroduction efforts have been reported in the San Pedro River Basin (SFB 1996a). This fish did not historically, nor presently, occur within the Fort Huachuca area (Young 1997).

Survival, successful reproduction, and recruitment of this species has declined from interactions with non-native fish, high winter flows, reduced high spring flows, seasonal changes in river temperatures, and lack of inundated shorelines and bottom lands. The razorback sucker has not been reported to occur on Fort Huachuca, and aquatic habitat on post is not suitable for this species (SFB 1996a).

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LISTED, PROPOSED, AND CANDIDATE SPECIES FOR THE FOLLOWING COUNTY: COCHISE

11/20/97

LISTED TOTAL= 19

NAME: CANELO HILLS LADIES' TRESSES *SPIRANTHES DELITESCENS*

STATUS: ENDANGERED CRITICAL HAB No RECOVERY PLAN: No CFR: 62 FR 665, 01-06-97

DESCRIPTION: SLENDER ERECT MEMBER OF THE ORCHID FAMILY (ORCHIDACEAE). FLOWER: STALK 50 CM TALL. MAY CONTAIN 40 WHITE FLOWERS SPIRALLY ARRANGED ON THE FLOWERING STALK.

ELEVATION RANGE: about 5000 FT.

COUNTIES: COCHISE, SANTA CRUZ

HABITAT: FINELY GRAINED, HIGHLY ORGANIC, SATURATED SOILS OF CIENEGAS

POTENTIAL HABITAT OCCURS IN SONORA, MEXICO, BUT NO POPULATIONS HAVE BEEN FOUND.

NAME: COCHISE PINCUSHION CACTUS *CORYPHANTHA ROBBINSORUM*

STATUS: THREATENED CRITICAL HAB No RECOVERY PLAN: Yes CFR: 51 FR 952, 1-9-1986

DESCRIPTION: A SMALL UNBRANCHED CACTUS WITH NO CENTRAL SPINES AND 11-17 WHITE RADIAL SPINES. THE BELL-SHAPED FLOWERS ARE BORNE ON THE ENDS OF TUBERCULES (Protrusions). FLOWERS: BELL SHAPED, PALE YELLOW-GREEN. FRUITS: ORANGE-RED TO RED

ELEVATION RANGE: >4200 FT.

COUNTIES: COCHISE AND SONORA, MEXICO

HABITAT: SEMIDESERT GRASSLAND WITH SMALL SHRUBS, AGAVE, OTHER CACTI, AND GRAMA GRASS.

GROWS ON GRAY LIMESTONE HILLS.

NAME: HUACHUCA WATER UMBEL *LILAEOPSIS SCHAFFNERIANA ssp RECURVA*

STATUS: ENDANGERED CRITICAL HAB No RECOVERY PLAN: No CFR: 62 FR 665, 01-06-97

DESCRIPTION: HERBACEOUS, SEMI-AQUATIC PERENNIAL IN THE PARSLEY FAMILY (UMBELLIFERAE) WITH SLENDER ERECT, HOLLOW, LEAVES THAT GROW FROM THE NODES OF CREEPING RHIZOMES. FLOWER: 3 TO 10 FLOWERED UMBELS ARISE FROM ROOT NODES.

ELEVATION RANGE: 3500-6500 FT.

COUNTIES: PIMA, SANTA CRUZ, COCHISE

HABITAT: CIENEGAS, PERENNIAL LOW GRADIENT STREAMS, WETLANDS

AND IN ADJACENT SONORA, MEXICO, WEST OF THE CONTINENTAL DIVIDE. POPULATIONS ALSO ON FORT HUACHUCA MILITARY RESERVATION.

FMC003601

NAME: **NEW MEXICAN RIDGE-NOSED RATTLESNAKE** *CROTALUS WILLARDI OBSCURUS*

STATUS: THREATENED CRITICAL HAB Yes RECOVERY PLAN: Yes CFR: 43 FR 34479, 04-04-1978

DESCRIPTION: SMALL 12-24 INCHES, SECRETIVE GRAYISH-BROWN WITH DISTINCT RIDGE ON THE END OF THE SNOUT. THE DORSAL SURFACE HAS OBSCURE, IRREGULARLY SPACED WHITE CROSSBARS EDGED WITH BROWN (NOT A BOLD PATTERN).

ELEVATION RANGE: 5600-9000 FT.

COUNTIES: COCHISE

HABITAT: PRESUMABLY CANYON BOTTOMS IN PINE-OAK & PINE-FIR COMMUNITIES WITH ALDER, MAPLE, OAK, & BOX ELDER

THE SUBSPECIES HAS NOT BEEN DOCUMENTED IN ARIZONA. HOWEVER, IT HAS BEEN OBSERVED NEAR THE ARIZONA BORDER IN THE PELONCILLO MOUNTAINS AND LIKELY OCCURS IN THE ARIZONA PORTION OF THAT RANGE AS WELL. ANOTHER SUBSPECIES, (CROTALUS WILLARDI WILLARDI), IS AN ARIZONA STATE CANDIDATE.

NAME: **JAGUAR, UNITED STATES POPULATION** *PANTHERA ONCA*

STATUS: ENDANGERED CRITICAL HAB No RECOVERY PLAN: No CFR: 62 FR 39147, 7-22-97

DESCRIPTION: MUSCULAR CAT WITH RELATIVELY SHORT, MASSIVE LIMBS AND A DEEP-CHESTED BODY. CINNAMON-BUFF IN COLOR WITH BLACK SPOTS.

ELEVATION RANGE: <8000 FT.

COUNTIES: COCHISE, PIMA, SANTA CRUZ

HABITAT: IN ARIZONA, RANGED WIDELY THROUGHOUT A VARIETY OF HABITATS FROM SONORAN DESERT TO CONIFER FORESTS

MOST RECORDS ARE FROM THE MADREAN EVERGREEN-WOODLAND, SHRUB-INVADED SEMI-DESERT GRASSLAND, AND ALONG RIVERS. HISTORIC RANGE IS CONSIDERED TO HAVE EXTENDED BEYOND THE COUNTIES LISTED ABOVE. REPORTS OF INDIVIDUALS IN THE SOUTHERN PART OF THE STATE CONTINUE TO BE RECEIVED. THE MOST RECENT RECORDS OF A JAGUAR IN THE U.S. ARE FROM THE NEW MEXICO/ARIZONA BORDER AREA AND IN SOUTHCENTRAL ARIZONA, BOTH IN 1996, AND CONFIRMED THROUGH PHOTOGRAPHS. UNCONFIRMED SIGHTINGS AND TRACKS CONTINUE TO BE REPORTED.

NAME: **JAGUARUNDI** *FELIS YAGOUAROUNDI TOLTECA*

STATUS: ENDANGERED CRITICAL HAB No RECOVERY PLAN: No CFR: 41 FR 24064; 06-14-76

DESCRIPTION: SMALL CAT WITH SHORT LEGS; SLENDER,ELONGATE BODY; AND LONG TAIL. HEAD SMALL & FLATTENED WITH SHORT ROUNDED EARS. REDDISH-YELLOW OR BLACKISH TO BROWN-GRAY IN COLOR AND WITHOUT SPOTS.

ELEVATION RANGE: 3500-6000 FT.

COUNTIES: SANTA CRUZ, PIMA, COCHISE

HABITAT: CAN BE FOUND IN A VARIETY OF HABITATS (SEE BELOW)

SEMI-ARID THORNY FORESTS, DECIDOUS FORESTS, HUMID PRE-MONTANE FORESTS, UPLAND DRY SAVANNAHS, SWAMPY GRASSLANDS, RIPARIAN AREAS, AND DENSE BRUSH. UNCONFIRMED REPORTS OF INDIVIDUALS IN THE SOUTHERN PART OF THE STATE CONTINUE TO BE RECEIVED. NO SPECIMENS HAVE BEEN COLLECTED IN ARIZONA.

NAME: LESSER LONG-NOSED BAT *LEPTONYCTERIS CURASOAE YERBABUENAE*

STATUS: ENDANGERED CRITICAL HAB No RECOVERY PLAN: Yes CFR: 53 FR 38456, 09-30-88

DESCRIPTION: ELONGATED MUZZLE, SMALL LEAF NOSE, AND LONG TONGUE. YELLOWISH BROWN OR GRAY ABOVE AND CINNAMON BROWN BELOW. TAIL MINUTE AND APPEARS TO BE LACKING. EASILY DISTURBED.

ELEVATION RANGE: <6000 FT.

COUNTIES: COCHISE, PIMA, SANTA CRUZ, GRAHAM, PINAL, MARICOPA

HABITAT: DESERT SCRUB HABITAT WITH AGAVE AND COLUNMNAR CACTI PRESENT AS FOOD PLANTS

DAY ROOSTS IN CAVES AND ABANDONED TUNNELS. FORAGES AT NIGHT ON NECTAR, POLLEN, AND FRUIT OF PANICULATE AGAVES AND COLUMNAR CACTI. THIS SPECIES IS MIGRATORY AND IS PRESENT IN ARIZONA, USUALLY FROM APRIL TO SEPTMBER AND SOUTH OF THE BORDER THE REMAINDER OF THE YEAR.

NAME: MEXICAN GRAY WOLF *CANIS LUPUS BAILEYI*

STATUS: ENDANGERED CRITICAL HAB No RECOVERY PLAN: Yes CFR: 32 FR 4001, 03-11-67; 43 FR 1912, 03-09-78

DESCRIPTION: LARGE DOG-LIKE CARNIVORE WITH VARYING COLOR, BUT USUALLY A SHADE OF GRAY. DISTINCT WHITE LIP LINE AROUND MOUTH. WEIGH 60-90 POUNDS.

ELEVATION RANGE: 4,000-12,00 FT.

COUNTIES: COCHISE, PIMA, SANTA CRUZ

HABITAT: CHAPPARAL, WOODLAND, AND FORESTED AREAS. MAY CROSS DESERT AREAS.

HISTORIC RANGE IS CONSIDERED TO BE LARGER THAN THE COUNTIES LISTED ABOVE. UNCONFIRMED REPORTS OF INDIVIDUALS IN THE SOUTHERN PART OF THE STATE CONTINUE TO BE RECEIVED. INDIVIDUALS MAY STILL PERSIST IN MEXICO.

NAME: OCELOT *FELIS PARDALIS*

STATUS: ENDANGERED CRITICAL HAB No RECOVERY PLAN: Yes CFR: 47 FR 31670; 07-21-82

DESCRIPTION: MEDIUM-SIZED SPOTTED CAT WHOSE TAIL IS ABOUT 1/2 THE LENGTH OF HEAD AND BODY. YELLOWISH WITH BLACK STREAKS AND STRIPES RUNNING FROM FRONT TO BACK. TAIL IS SPOTTED AND FACE IS LESS HEAVILY STREAKED THAN THE BACK AND SIDES.

ELEVATION RANGE: <8000 FT.

COUNTIES: SANTA CRUZ, PIMA, COCHISE

HABITAT: HUMID TROPICAL & SUB-TROPICAL FORESTS, SAVANNAHS, AND SEMI-ARID THORNSCRUB.

MAY PERSIST IN PARTLY-CLEARED FORESTS, SECOND-GROWTH WOODLAND, AND ABANDONED CULTIVATION REVERTED TO BRUSH. UNIVERSAL COMPONENT IS PRESENCE OF DENSE COVER. UNCONFIRMED REPORTS OF INDIVIDUALS IN THE SOUTHERN PART OF THE STATE CONTINUE TO BE RECEIVED.

NAME: **BEAUTIFUL SHINER** *CYPRINELLA FORMOSA*

STATUS: THREATENED CRITICAL HAB Yes RECOVERY PLAN: Yes CFR: 49 FR 34490, 8-31-1984

DESCRIPTION: SMALL (2.5 INCHES) SHINY MINNOW AND VERY SIMILAR TO RED SHINER. MALES COLORFUL DURING BREEDING (YELLOW-ORANGE OR ORANGE ON CAUDAL AND LOWER FINS AND BLUISH BODY.

ELEVATION RANGE: <4500 FT.

COUNTIES: COCHISE

HABITAT: SMALL TO MEDIUM SIZED STREAMS AND PONDS WITH SAND, GRAVEL, AND ROCK BOTTOMS.

VIRTUALLY EXTIRPATED IN THE UNITED STATES, WITH THE EXCEPTION OF A FEW ISOLATED POPULATIONS ON NATIONAL WILDLIFE REFUGES AND IN MEXICO. SAME CRITICAL HABITAT AS YAQUI CHUB AND CATFISH (SEE 49 FR 34490, 08-31-1984).

NAME: **YAQUI CATFISH** *ICTALURUS PRICEI*

STATUS: THREATENED CRITICAL HAB Yes RECOVERY PLAN: Yes CFR: 49 FR 34490, 08-31-1984

DESCRIPTION: SIMILAR TO CHANNEL CATFISH (Ictalurus punctatus) EXCEPT ANAL FIN BASE IS SHORTER AND THE DISTAL MARGIN OF THE ANAL FIN IS BROADLY ROUNDED WITH 23-25 SOFT RAYS. BODY USUALLY PROFUSELY SPECKLED.

ELEVATION RANGE: 4000-5000 FT.

COUNTIES: COCHISE

HABITAT: MODERATE TO LARGE STREAMS WITH SLOW CURRENT OVER SAND AND ROCK BOTTOMS

CRITICAL HABITAT ALL AQUATIC HABITATS IN THE MAIN PORTION OF SAN BERNADINO NATIONAL WILDLIFE REFUGE

NAME: **YAQUI CHUB** *GILA PURPUREA*

STATUS: ENDANGERED CRITICAL HAB Yes RECOVERY PLAN: Yes CFR: 49 FR 34490, 08-31-1984

DESCRIPTION: MEDIUM SIZED MINNOW (<6 INCHES) DARK COLORED, LIGHTER BELOW. DARK TRIANGULAR CAUDAL SPOT

ELEVATION RANGE: 4000-6000 FT.

COUNTIES: COCHISE (AZ), MEXICO

HABITAT: DEEP POOLS OF SMALL STREAMS, POOLS, OR PONDS NEAR UNDERCUT BANKS.

CRITICAL HABITAT INCLUDES ALL AQUATIC HABITATS OF THE MAIN PORTION SAN BERNADINO NATIONAL WILDLIFE REFUGE.

LISTED, PROPOSED, AND CANDIDATE SPECIES FOR THE FOLLOWING COUNTY: COCHISE

11/20/97

NAME: YAQUI TOPMINNOW *POECILIOPSIS OCCIDENTALIS SONORIENSIS*

STATUS: ENDANGERED CRITICAL HAB No RECOVERY PLAN: Yes CFR: 32 FR 4001, 03-11-1967

DESCRIPTION: SMALL (2 INCHES) TOPMINNOW GUPPY-LIKE, LIVE BEARING, LACKING DARK SPOTS. BREEDING MALES JET BLACK WITH YELLOW FINS.

ELEVATION RANGE: <4500 FT.

COUNTIES: COCHISE

HABITAT: SMALL TO MODERATE SIZED STREAMS, SPRINGS, & CIENEGAS GENERALLY IN SHALLOWS

NAME: AMERICAN PEREGRINE FALCON *FALCO PEREGRINUS ANATUM*

STATUS: ENDANGERED CRITICAL HAB No RECOVERY PLAN: Yes CFR: 35 FR 16047, 10-13-70; 35 FR 8495, 06-02-70

DESCRIPTION: A RECLUSIVE, CROW-SIZED FALCON SLATY BLUE ABOVE WHITISH BELOW WITH FINE DARK BARRING. THE HEAD IS BLACK AND APPEARS TO BE MASKED OR HELMETED. WINGS LONG AND POINTED. LOUD WAILING CALLS ARE GIVEN DURING BREEDING PERIOD.

ELEVATION RANGE: 3500-9000 FT.

COUNTIES: MOHAVE COCONINO NAVAJO APACHE SANTA CRUZ MARICOPA COCHISE YAVAPAI GILA PINAL PIMA GREENLEE GRAHAM

HABITAT: CLIFFS AND STEEP TERRAIN USUALLY NEAR WATER OR WOODLANDS WITH ABUNDANT PREY

THIS IS A WIDE-RANGING MIGRATORY BIRD THAT USES A VARIETY OF HABITATS. BREEDING BIRDS ARE YEAR-ROUND RESIDENTS. OTHER BIRDS WINTER AND MIGRATE THROUGH ARIZONA. SPECIES IS ENDANGERED FROM REPRODUCTIVE FAILURE FROM PESTICIDES.

NAME: MEXICAN SPOTTED OWL *STRIX OCCIDENTALIS LUCIDA*

STATUS: THREATENED CRITICAL HAB Yes RECOVERY PLAN: Yes CFR: 56 FR 14678, 04-11-91

DESCRIPTION: MEDIUM SIZED WITH DARK EYES AND NO EAR TUFTS. BROWNISH AND HEAVILY SPOTTED WITH WHITE OR BEIGE.

ELEVATION RANGE: 4100-9000 FT.

COUNTIES: MOHAVE, COCONINO, NAVAJO, APACHE, YAVAPAI, GRAHAM, GREENLEE, COCHISE, SANTA CRUZ, PIMA, PINAL, GILA, MARICOPA

HABITAT: NESTS IN CANYONS AND DENSE FORESTS WITH MULTI-LAYERED FOLIAGE STRUCTURE

GENERALLY NESTS IN OLDER FORESTS OF MIXED CONIFER OR PONDERSA PINE/GAMBEL OAK TYPE, IN CANYONS, AND USE VARIETY OF HABITATS FOR FORAGING. SITES WITH COOL MICROCLIMATES APPEAR TO BE OF IMPORTANCE OR ARE PREFERED.

NAME: NORTHERN APLOMADO FALCON *FALCO FEMORALIS SEPTENTRIONALIS*

STATUS: ENDANGERED CRITICAL HAB No RECOVERY PLAN: Yes CFR: 51 FR 6686, 01-25-86

DESCRIPTION: RUFOUS UNDERPARTS, GRAY BACK, LONG BANDED TAIL, AND A DISTINCT BLACK AND WHITE FACIAL PATTERN. SMALLER THAN PEREGRINE LARGER THAN KESTREL. BREEDS BETWEEN MARCH- JUNE

ELEVATION RANGE: 3500-9000 FT.

COUNTIES: COCHISE, SANTA CRUZ

HABITAT: GRASSLAND AND SAVANNAH

SPECIES FORMERLY NESTED IN SOUTHWESTERN US. NOW OCCURS AS AN ACCIDENTAL. GOOD HABITAT HAS LOW GROUND COVER AND MESQUITE OR YUCCA FOR NESTING PLATFORMS. CONTINUED USE OF PESTICIDES IN MEXICO ENDANGERS THIS SPECIES. NO RECENT CONFIRMED REPORTS FOR ARIZONA.

NAME: SOUTHWESTERN WILLOW FLYCATCHER *EMPIDONAX TRAILLII EXTIMUS*

STATUS: ENDANGERED CRITICAL HAB Yes RECOVERY PLAN: No CFR: 60 FR 10694, 02-27-95

DESCRIPTION: SMALL PASSERINE (ABOUT 6") GRAYISH-GREEN BACK AND WINGS, WHITISH THROAT, LIGHT OLIVE-GRAY BREAST AND PALE YELLOWISH BELLY. TWO WINGBARS VISIBLE. EYE-RING FAINT OR ABSENT.

ELEVATION RANGE: <8500 FT.

COUNTIES: YAVAPAI, GILA, MARICOPA, MOHAVE, COCONINO, NAVAJO, APACHE, PINAL, LA PAZ, GREENLEE, GRAHAM, YUMA, PIMA, COCHISE, SANTA CRUZ

HABITAT: COTTONWOOD/WILLOW & TAMARISK VEGETATION COMMUNITIES ALONG RIVERS & STREAMS

MIGRATORY RIPARIAN OBLIGATE SPECIES THAT OCCUPIES BREEDING HABITAT FROM LATE APRIL TO SEPTEMBER. DISTRIBUTION WITHIN ITS RANGE IS RESTRICTED TO RIPARIAN CORRIDORS. DIFFICULT TO DISTINGUISH FROM OTHER MEMBERS OF THE EMPIDONAX COMPLEX BY SIGHT ALONE. TRAINING SEMINAR REQUIRED FOR THOSE CONDUCTING FLYCATCHER SURVEYS. CRITICAL HABITAT ON PORTIONS OF THE 100-YEAR FLOODPLAIN ON SAN PEDRO AND VERDE RIVERS; WET BEAVER AND WEST CLEAR CREEKS, INCLUDING TAVASCI MARSH AND ISTER FLAT; THE COLORADO RIVER, THE LITTLE COLORADO RIVER, AND THE WEST, EAST, AND SOUTH FORKS OF THE LITTLE COLORADO RIVER, REFERENCE 60 CFR:62 FR 39129, 7/22/97.

NAME: WHOOPING CRANE *GRUS AMERICANA*

STATUS: ENDANGERED CRITICAL HAB Yes RECOVERY PLAN: Yes CFR: 32 FR 4001, 03-11-1967; 43 FR 20938, 05-15-78

DESCRIPTION: TALLEST AMERICAN BIRD (UP TO 5 FEET) SNOWY WHITE, LONG NECK AND LEGS, BLACK WING TIPS, RED CROWN, AND BLACK WEDGE SHAPED PATCH OF FETHERS BEHIND ITS EYE.

ELEVATION RANGE: 4500 FT.

COUNTIES: COCHISE

HABITAT: MARSHES, PRAIRIES, RIVER BOTTOMS

BIRDS IN THE ROCKY MOUNTAIN POPULATION ARE OCCASIONAL VISITORS IN ARIZONA DURING MIGRATION. USUALLY NEAR WILCOX PLAYA.

NAME: SONORA TIGER SALAMANDER *AMBYSTOMA TIGRINUM STEBBINSI*

STATUS: ENDANGERED CRITICAL HAB No RECOVERY PLAN: No CFR: 62 FR 665, 01-06-97

DESCRIPTION: 2.6 TO 4.9" SNOUT-VENT LENGTH WITH LIGHT-COLORED BANDS ON A DARK BACKGROUND. AQUATIC LARVAE ARE UNIFORM DARK COLOR WITH PLUME-LIKE GILLS AND TAIN FINS.

ELEVATION RANGE: 4000-6300 FT.

COUNTIES: SANTA CRUZ, COCHISE

HABITAT: STOCK TANKS AND IMPOUNDED CIENEGAS IN SAN RAFAEL VALLEY, HUACHUCA MOUNTAINS

ALSO OCCURS IN THE FOOTHILLS OF THE EAST SLOPE OF THE PATAGONIA AND HUACHUCA MOUNTAINS. POPULATIONS ALSO ON FORT HUACHUCA.

CANDIDATE TOTAL= 6

NAME: **BLUMER'S DOCK** *RUMEX ORTHONEURUS*

STATUS: CANDIDATE CRITICAL HAB No RECOVERY PLAN: No CFR:

DESCRIPTION: LARGE LONG-LIVED PERENNIAL PLANT IN THE BUCKWHEAT FAMILY THAT CAN REACH 1.2-2.0 METERS. LARGE BROAD, OVAL SEMI-SUCCULENT LEAVES ARE BRIGHT GREEN. CONSPICOUS SECONDARY VEINS AT RIGHT ANGLES TO THE MIDVEIN

ELEVATION RANGE: 6500-9000 FT.

COUNTIES: GILA, COCHISE

HABITAT: MID TO HIGH ELEVATION SPRINGS, STREAMS, & WETLANDS WITH MOIST ORGANIC SOILS OR SHADED CANYONS

NAME: **LEMMON FLEABANE** *ERIGERON LEMMONII*

STATUS: CANDIDATE CRITICAL HAB No RECOVERY PLAN: No CFR:

DESCRIPTION: A PROSTRATE PERENNIAL IN THE SUNFLOWER FAMILY. STEMS AND LEAVES ARE DENSELY HAIRY. FLOWERS LOOK LIKE SMALL DELICATE DAISIES, WITH WHITE TO LIGHT PURPLE OUTER PETALS AND YELLOW INNER PETALS.

ELEVATION RANGE: 1500-6000 FT.

COUNTIES: COCHISE

HABITAT: GROWS IN DENSE CLUMPS IN CREVICES, LEDGES, AND BOULDERS IN CANYON BOTTOMS IN PINE-OAK WOODLAND

NAME: **GILA CHUB** *GILA INTERMEDIA*

STATUS: CANDIDATE CRITICAL HAB No RECOVERY PLAN: No CFR:

DESCRIPTION: DEEP COMPRESSED BODY, FLAT HEAD. DARK OLIVE-GRAY COLOR ABOVE, SILVER SIDES. ENDEMIC TO GILA RIVER BASIN.

ELEVATION RANGE: 2000 - 3500 FT.

COUNTIES: SANTA CRUZ, GILA, GREENLEE, PIMA, COCHISE, GRAHAM, YAVAPAI

HABITAT: POOLS, SPRINGS, CIENEGAS, AND STREAMS

MULTIPLE PRIVATE LANDOWERS, INCLUDING THE NATURE CONSERVANCY, THE AUDUBON SOCIETY, AND OTHERS. ALSO FT. HUACHUCA. SPECIES ALSO FOUND IN SONORA, MEXICO.

LISTED, PROPOSED, AND CANDIDATE SPECIES FOR THE FOLLOWING COUNTY: COCHISE

11/20/97

NAME: HUACHUCA SPRINGSNAIL *PYRGULOPSIS THOMPSONI*

STATUS: CANDIDATE CRITICAL HAB No RECOVERY PLAN: No CFR:

DESCRIPTION: VERY SMALL (1.7-3.2mm) CONICAL SHELL. IDENTIFICATION MUST BE VERIFIED BY CHARARCTERISTICS OF REPRODUCTIVE ORGANS.

ELEVATION RANGE: 4500-6000 FT.

COUNTIES: COCHISE, SANTA CRUZ

HABITAT: AQUATIC AREAS, SMALL SPRINGS WITH VEGETATION SLOW TO MODERATE FLOW.

INDIVIDUALS FOUND ON FIRM SUBSTANCES (ROOTS, WOOD, AND ROCKS)

NAME: MOUNTAIN PLOVER *CHARADRIUS MONTANUS*

STATUS: CANDIDATE CRITICAL HAB No RECOVERY PLAN: No CFR:

DESCRIPTION: WADING BIRD; COMPACTLY BUILT; iIN BREEDING SEASON WITH WHITE FOREHEAD AND LINE OVER THE EYE; CONTRASTING WITH DARK CROWN; NONDESCRIPT IN WINTER. VOICE IS LOW, VARIABLE WHISTLE.

ELEVATION RANGE: 0 FT.

COUNTIES: YUMA, SANTA CRUZ, PIMA, COCHISE

HABITAT:

NAME: CHIRICAHUA LEOPARD FROG *RANA CHIRICAHUENSIS*

STATUS: CANDIDATE CRITICAL HAB No RECOVERY PLAN: No CFR: 59 FR 58996

DESCRIPTION: CREAM COLORED TUBERCULES (spots) ON A DARK BACKGROUND ON THE REAR OF THE THIGH, DORSOLATERAL FOLDS THAT ARE INTERRUPTED AND DEFLECTED MEDIALLY, AND A CALL GIVEN OUT OF WATER DISTINGUISH THIS SPOTTED FROG FROM OTHER LEOPRD

ELEVATION RANGE: 3000-8300 FT.

COUNTIES: SANTA CRUZ, APACHE, GILA, PIMA, COCHISE, GREENLEE, GRAHAM, YAVAPAI, COCONINO, NAVAJO

HABITAT: STREAMS, RIVERS, BACKWATERS, PONDS, AND STOCK TANKS THAT ARE FREE FROM INTRODUCED FISH AND BULLFROGS

REQUIRE PERMANENT OR NEARLY PERMANENT WATER SOURCES. POPULATIONS NORTH OF THE GILA RIVER ARE THOUGHT TO BE CLOSELY-RELATED, BUT DISTINCT, UNDESCRIBED SPECIES.

THE STATE OF ARIZONA

GAME & FISH DEPARTMENT

2221 West Greenway Road, Phoenix, Arizona 85023-4399 (602) 942-3000

Governor
Jane Dee Hull

Commissioners:
Chairman, Michael M. Golightly, Flagstaff
Herb Guenther, Tacna
M. Jean Hassell, Scottsdale
Dennis D. Manning, Alpine

Director
Duane L. Shroufe

Deputy Director
Thomas W. Spalding

February 27, 1998

Mr. Michael Collins
SAIC
2702 North 44th Street, Suite 102A
Phoenix, Arizona 85008

Re: Special Status Species; Fort Huachuca Military Installation and San Pedro Riparian National Conservation Area

Dear Mr. Collins:

The Arizona Game and Fish Department (Department) has received your letter, dated February 4, 1998, regarding special status species in the above-referenced areas, and the following information is provided.

The Department's Heritage Data Management System has been accessed and current records show that the special status species listed below have been documented as occurring within the boundaries of San Pedro Riparian National Conservation Area.

COMMON NAME	SCIENTIFIC NAME	STATUS
Baird's sparrow	*Ammodramus bairdii*	**WC,S**
black-bellied whistling-duck	*Dendrocygna autumnalis*	**WC,S**
Chiricahua leopard frog	*Rana chiricahuensis*	**C,WC,S**
greater Western mastiff bat	*Eumops perotis californicus*	**S**
lesser long-nosed bat	*Leptonycteris curasoae yerbabuenae*	**LE,WC,S**
lowland leopard frog	*Rana yavapaiensis*	**WC,S**
Mexican garter snake	*Thamnophis eques megalops*	**WC,S**
Northern beardless-tyrannulet	*Camptostoma imberbe*	**S**
Northern gray hawk	*Buteo nitidus maximus*	**WC,S**
Southwestern willow flycatcher	*Empidonax traillii extimus*	**LE,WC**
tropical kingbird	*Tyrannus melancholicus*	**WC,S**
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	**WC,S**
white-tailed kite	*Elanus caeruleus*	**S**

Current records show that the special status species on the attached lists have been documented as occurring within the boundaries of Fort Huachuca Military Installation and within 10 miles of Fort Huachuca Military Installation.

FMC003610

Thank you for the opportunity to provide this information. If you have any questions, please contact me at (602) 789-3606.

Sincerely,

Nancy Olson

Nancy Olson
Project Evaluation Specialist
Habitat Branch

NLO:no

Enclosures (2)

cc: Joan Scott, Habitat Program Manager, Region V, Tucson

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ARIZONA GAME AND FISH DEPARTMENT
HERITAGE DATA MANAGEMENT SYSTEM QUERY

SPECIAL STATUS SPECIES
DOCUMENTED WITHIN FORT HUACHUCA MILITARY INSTALLATION

COMMON NAME	SCIENTIFIC NAME	ESA	WSCA	USFS	NPL
ARIZONA RIDGENOSE RATTLESNAKE	CROTALUS WILLARDI WILLARDI		WC	S	
ARIZONA SHREW	SOREX ARIZONAE	SC	WC	S	
BLUE-THROATED HUMMINGBIRD	LAMPORNIS CLEMENCIAE			S	
BUNCH GRASS LIZARD	SCELOPORUS SCALARIS			S	
CAVE MYOTIS	MYOTIS VELIFER	SC			
CHIRICAHUA LEOPARD FROG	RANA CHIRICAHUENSIS	C	WC	S	
DESERT MASSASAUGA	SISTRURUS CATENATUS EDWARDSI		WC	S	
ELEGANT TROGON	TROGON ELEGANS		WC	S	
GREEN DEATH CAMAS	ZIGADENUS VIRESCENS				SR
HUACHUCA GOLDEN ASTER	HETEROTHECA RUTTERI	SC			
HUACHUCA SPRINGSNAIL	PYRGULOPSIS THOMPSONI	C			
HUACHUCA WATER UMBEL	LILAEOPSIS SCHAFFNERIANA VAR RECURVA	LE		S	HS
LEAFY LOBELIA	LOBELIA FENESTRALIS				SR
LEMMON FLEABANE	ERIGERON LEMMONII	C		S	HS
LEMMON LILY	LILIUM PARRYI	SC		S	SR
LEMMON'S ASTER	ASTER POTOSINUS			S	
LESSER LONG-NOSED BAT	LEPTONYCTERIS CURASOAE YERBABUENAE	LE	WC	S	
MADREAN ADDERS MOUTH	MALAXIS CORYMBOSA				SR
MEXICAN GARTER SNAKE	THAMNOPHIS EQUES MEGALOPS	SC	WC	S	
MEXICAN LONG-TONGUED BAT	CHOERONYCTERIS MEXICANA	SC	WC	S	
MEXICAN SPOTTED OWL	STRIX OCCIDENTALIS LUCIDA	LT	WC	S	
MOUNTAIN SKINK	EUMECES TETRAGRAMIS CALLICEPHALUS			S	
NORTHERN BUFF-BREASTED FLYCATCHER	EMPIDONAX FULVIFRONS PYGMAEUS	SC	WC	S	
NORTHERN GOSHAWK	ACCIPITER GENTILIS	SC	WC	S	
PLUMMER ONION	ALLIUM PLUMMERAE				SR
PRINGLE HAWKWEED	HIERACIUM PRINGLEI	SC			
RAMSEY CANYON LEOPARD FROG	RANA SUBAQUAVOCALIS	SC			
WESTERN RED BAT	LASIURUS BLOSSEVILLII		WC	S	
WILCOX FISHHOOK CACTUS	MAMMILLARIA WRIGHTII VAR WILCOXII				SR
WOODLAND SPURGE	EUPHORBIA PLUMMERAE	SC		S	SR
YELLOW-NOSED COTTON RAT	SIGMODON OCHROGNATHUS	SC			

ARIZONA GAME AND FISH DEPARTMENT
HERITAGE DATA MANAGEMENT SYSTEM QUERY
WITHIN 10 MILES OF FORT HUACHUCA MILITARY INSTALLATION
SPECIAL STATUS SPECIES

COMMON NAME	SCIENTIFIC NAME	ESA	WSCA	USFS	NPL
AMERICAN PEREGRINE FALCON	FALCO PEREGRINUS ANATUM	LE	WC	S	
ARIZONA CAVE AMPHIPOD	STYGOBROMUS ARIZONENSIS	SC		S	
ARIZONA RIDGENOSE RATTLESNAKE	CROTALUS WILLARDI WILLARDI		WC	S	
ARIZONA SHREW	SOREX ARIZONAE	SC	WC	S	
BAIRD'S SPARROW	AMMODRAMUS BAIRDII	SC	WC	S	
BEARDLESS CHINCH WEED	PECTIS IMBERBIS	SC		S	
BERYLLINE HUMMINGBIRD	AMAZILIA BERYLLINA			S	
BLACK-BELLIED WHISTLING-DUCK	DENDROCYGNA AUTUMNALIS		WC	S	
BLACK-TAILED PRAIRIE DOG	CYNOMYS LUDOVICIANUS		WC		
BLUE-THROATED HUMMINGBIRD	LAMPORNIS CLEMENCIAE			S	
BLUMER'S DOCK	RUMEX ORTHONEURUS	C		S	HS
BUNCH GRASS LIZARD	SCELOPORUS SCALARIS			S	
CAVE MYOTIS	MYOTIS VELIFER	SC			
CHIRICAHUA LEOPARD FROG	RANA CHIRICAHUENSIS	C	WC	S	
DESERT MASSASAUGA	SISTRURUS CATENATUS EDWARDSI		WC	S	
DESERT SUCKER	CATOSTOMUS CLARKI	SC			
EHRENBERG ADDERS MOUTH	MALAXIS EHRENBERGII				SR
ELEGANT TROGON	TROGON ELEGANS		WC	S	
FALLEN LADIES'-TRESSES	SPIRANTHES PARASITICA				SR
GILA CHUB	GILA INTERMEDIA	C	WC	S	
GILA TOPMINNOW	POECILIOPSIS OCCIDENTALIS OCCIDENTALIS	LE	WC	S	
GREATER WESTERN MASTIFF BAT	EUMOPS PEROTIS CALIFORNICUS	SC		S	
GREEN DEATH CAMAS	ZIGADENUS VIRESCENS				SR
HUACHUCA GOLDEN ASTER	HETEROTHECA RUTTERI	SC			
HUACHUCA GROUNDSEL	SENECIO HUACHUCANUS			S	HS
HUACHUCA MILK-VETCH	ASTRAGALUS HYPOXYLUS	SC		S	SR
HUACHUCA SPRINGSNAIL	PYRGULOPSIS THOMPSONI	C			
HUACHUCA WATER UMBEL	LILAEOPSIS SCHAFFNERIANA VAR RECURVA	LE		S	HS
JAGUARUNDI	FELIS YAGOUAROUNDI TOLTECA	LE		S	
LEAFY LOBELIA	LOBELIA FENESTRALIS				SR
LEMMON FLEABANE	ERIGERON LEMMONII	C		S	HS
LEMMON LILY	LILIUM PARRYI	SC		S	SR
LEMMON'S ASTER	ASTER POTOSINUS			S	
LESSER LONG-NOSED BAT	LEPTONYCTERIS CURASOAE YERBABUENAE	LE	WC	S	
LONGFIN DACE	AGOSIA CHRYSOGASTER	SC			
LOWLAND LEOPARD FROG	RANA YAVAPAIENSIS	SC	WC	S	
LUCIFER HUMMINGBIRD	CALOTHORAX LUCIFER			S	
MADREAN ADDERS MOUTH	MALAXIS CORYMBOSA				SR
MADREAN LADIES'-TRESSES	SPIRANTHES DELITESCENS	LE		S	HS
MEXICAN GARTER SNAKE	THAMNOPHIS EQUES MEGALOPS	SC	WC	S	
MEXICAN LONG-TONGUED BAT	CHOERONYCTERIS MEXICANA	SC	WC	S	
MEXICAN SPOTTED OWL	STRIX OCCIDENTALIS LUCIDA	LT	WC	S	
MOUNTAIN SKINK	EUMECES TETRAGRAMIS CALLICEPHALUS			S	
NEW SPECIES FROM ARIZONA	BROWALLIA ELUDENS	SC			
NORTHERN BEARDLESS-TYRANNULET	CAMPTOSTOMA IMBERBE			S	
NORTHERN BUFF-BREASTED FLYCATCHER	EMPIDONAX FULVIFRONS PYGMAEUS	SC	WC	S	
NORTHERN GOSHAWK	ACCIPITER GENTILIS	SC	WC	S	
NORTHERN GRAY HAWK	BUTEO NITIDUS MAXIMUS	SC	WC	S	
PALE TOWNSEND'S BIG-EARED BAT	PLECOTUS TOWNSENDII PALLESCENS	SC			
PINOS ALTOS FLAME FLOWER	TALINUM HUMILE	SC		S	SR
PLUMMER ONION	ALLIUM PLUMMERAE				SR
PRINGLE HAWKWEED	HIERACIUM PRINGLEI	SC			
RAMSEY CANYON LEOPARD FROG	RANA SUBAQUAVOCALIS	SC			

ARIZONA GAME AND FISH DEPARTMENT
HERITAGE DATA MANAGEMENT SYSTEM QUERY
WITHIN 10 MILES OF FORT HUACHUCA MILITARY INSTALLATION
SPECIAL STATUS SPECIES

COMMON NAME	SCIENTIFIC NAME	ESA	WSCA	USFS	NPL
REDFLOWER ONION	ALLIUM RHIZOMATUM				SR
ROUNDTAIL CHUB	GILA ROBUSTA	SC	WC	S	
SONORA SUCKER	CATOSTOMUS INSIGNIS	SC			
SONORAN DESERT TORTOISE	GOPHERUS AGASSIZII (SONORAN POPULATION)	SC	WC	S	
SONORAN TIGER SALAMANDER	AMBYSTOMA TIGRINUM STEBBINSI	LE	WC	S	
SOUTHWESTERN WILLOW FLYCATCHER	EMPIDONAX TRAILLII EXTIMUS	LE	WC		
SPRAGUE'S PIPIT	ANTHUS SPRAGUEII		WC	S	
TEPIC FLAME FLOWER	TALINUM MARGINATUM	SC		S	SR
TEXAS HORNED LIZARD	PHRYNOSOMA CORNUTUM	SC			
TEXAS PURPLE SPIKE	HEXALECTRIS WARNOCKII	SC			HS
THURBER BOG ORCHID	HABENARIA LIMOSA				SR
TROPICAL KINGBIRD	TYRANNUS MELANCHOLICUS		WC	S	
VIOLET-CROWNED HUMMINGBIRD	AMAZILIA VIOLICEPS		WC	S	
WESTERN BARKING FROG	ELEUTHERODACTYLUS AUGUSTI CACTORUM		WC	S	
WESTERN RED BAT	LASIURUS BLOSSEVILLII		WC	S	
WESTERN YELLOW-BILLED CUCKOO	COCCYZUS AMERICANUS OCCIDENTALIS		WC	S	
WHITE-TAILED KITE	ELANUS CAERULEUS			S	
WILCOX FISHHOOK CACTUS	MAMMILLARIA WRIGHTII VAR WILCOXII				SR
WOODLAND SPURGE	EUPHORBIA PLUMMERAE	SC		S	SR
YELLOW-NOSED COTTON RAT	SIGMODON OCHROGNATHUS	SC			
ZONE-TAILED HAWK	BUTEO ALBONOTATUS			S	

STATUS DEFINITIONS

LE - **Listed Endangered.** Species identified by the U.S. Fish and Wildlife Service (USFWS) under the Endangered Species Act (ESA) as being in imminent jeopardy of extinction.

LT - **Listed Threatened.** Species identified by USFWS under ESA as being in imminent jeopardy of becoming Endangered.

C - **Candidate.** Species for which USFWS has sufficient information on biological vulnerability and threats to support proposals to list as Endangered or Threatened under ESA. However, proposed rules have not yet been issued because such actions are precluded at present by other listing activity.

SC **Species of Concern.** The terms "Species of Concern" or "Species at Risk" should be considered as terms-of-art that describe the entire realm of taxa whose conservation status may be of concern to the USFWS, but neither term has official status. A 1994 Memorandum of Understanding between Federal land and wildlife management agencies calls for cooperation in the conservation of these species in an effort to reduce, mitigate, and possibly eliminate the need for future listing of these species under ESA.

WC - **Wildlife of Special Concern in Arizona.** Species whose occurrence in Arizona is or may be in jeopardy, or with known or perceived threats or population declines, as described by the Department's listing of **Wildlife of Special Concern in Arizona** (WSCA, in prep.). Species included in WSCA are currently the same as those in **Threatened Native Wildlife in Arizona** (1988).

S - **Sensitive.** Species classified as "sensitive" by the Regional Forester when occurring on lands managed by the U.S.D.A. Forest Service.

HS - **Highly Safeguarded.** Those Arizona native plants whose prospects for survival in this state are in jeopardy or are in danger of extinction, or are likely to become so in the foreseeable future, as described by the Arizona Native Plant Law (1993).

SR - **Salvage Restricted.** Those Arizona native plants not included in the Highly Safeguarded Category, but that have a high potential for theft or vandalism, as described by the Arizona Native Plant Law (1993).

APPENDIX C AIR QUALITY INVESTIGATION

C.1 INTRODUCTION

This appendix is a systematic examination of the effects on air quality of the activities expected to occur at Fort Huachuca during the next 5 years. These activities include ongoing operations as well as new programs and construction associated with them. The examination was carried out in the context of regulations pertaining to emission rates and concentrations of air contaminants of the U. S. Environmental Protection Agency and other federal agencies, and of the Arizona Department of Environmental Quality. Human health and safety issues relating to those contaminants were examined with respect to standards established by the American Conference of Governmental Industrial Hygienists (ACGIH 1994), and by the Occupational Safety and Health Administration (OSHA).

C.2 AIR QUALITY STANDARDS

Fort Huachuca is located in the Southeast Arizona Intrastate Air Quality Control Region which encompasses the counties of Cochise, Graham, Greenlee, and Santa Cruz. Air quality regions in Arizona are identified by the extent to which they meet Ambient Air Quality Standards for 5 critical pollutants: particulate matter smaller than 10 μm in diameter (PM_{10}), sulfur oxides (SO_x), ozone (O_3), carbon monoxide (CO), and nitrogen dioxide (NO_2).

Arizona and federal primary and secondary standards and their regulatory significance are summarized in Table C-1. Arizona standards are equivalent to the corresponding federal standards. In addition, Arizona regulations limit increases in concentrations of certain pollutants above baseline values in Class I, II, and III areas. These standards are summarized in Table C-2 and Table C-3.

C.3 AIR QUALITY BASELINE

There are several areas with Ambient Air Quality Standard non-attainment findings in the general vicinity of Fort Huachuca (Guidden 1993). An area in extreme south-central Cochise County, including the City of Douglas, is in non-attainment for PM_{10} and part of that area also is in non-attainment for sulfur dioxide. An area in extreme south-central Santa Cruz County surrounding Nogales also is in non-attainment for PM_{10}. To the northwest, a large area of Pima County surrounding Tucson is in non-attainment for carbon monoxide and/or PM_{10}. These non-attainment areas are approximately thirty miles from Fort Huachuca. Emissions from Fort Huahcuca do not contribute to the non-attainment status of these areas.

FMC003615

Table C-1. Federal and Arizona Standards for Ambient Air Quality.

Contaminant and Averaging Time	Federal and Arizona Primary Standard	Federal and Arizona Secondary Standard
Particulate Matter (PM10)[1]		
24-hour average[2]	150 mg/m^3	150 mg/m^3
Annual arithmetic mean[3]	50 mg/m^3	50 mg/m^3
Sulfur Oxides (SOx)		
24-hour average	365 mg/m^3(0.14 ppm)	–
Annual arithmetic mean	80 mg/m^3(0.03 ppm)	–
3-hour average	–	1300 mg/m^3(0.5 ppm)
Ozone		
1-hour average[4]	0.12 ppm (235 mg/m^3)	0.12 ppm (235 mg/m^3)
Carbon Monoxide		
8-hour average	9 ppm (10 mg/m^3)	–
1-hour average	35 ppm (40 mg/m^3)	–
Nitrogen Dioxide		
Annual arithmetic average	0.053 ppm (100 mg/m^3)	0.053 ppm (100 mg/m^3)
Lead		
Calendar quarter arithmetic meanc	1.5 mg/m^3	1.5 mg/m^3

Source: 40 CFR 50 and Arizona Administrative Rules and Regulations, Title 18 Environmental Quality; Chapter 2 Air Pollution Control, Article 2; Ambient Air Quality Standards; Adopted effective May 14, 1979; last amended effective January 21, 1990.

1. Particulate matter is to be measured as PM10, i.e., particles with an aerodynamic diameter of 10 mm.
2. Not to be exceeded more than once per year.
3. Not to be exceeded.
1. No more than one day per year should have maximum 1-hour average concentrations greater than the standard.

Table C-2. Maximum Allowable Increases

Pollutant and Averaging Time	Maximum Allowable Concentration Increase ($\mu g/m^3$)
Total Suspended Particulates	
Annual geometric mean	19
24-hour maximum	37
Sulfur dioxide	
Annual Arithmetic mean	20
24-hour maximum	91
3-hour maximum	512
Nitrogen dioxide	
Annual arithmetic mean	25

Source: Arizona Administrative Rules and Regulations, Title 18-Environmental Quality; Chapter 2-Air Pollution Control, Article 2; Ambient Air Quality Standards.

Table C-3. Arizona Maximum Allowable Air Quality Impacts of New and Altered Sources.

Pollutant	Air Quality Concentration (µg/m^3)	Averaging Time
Carbon monoxide	575	8 hours
Nitrogen dioxide	14	Annual
Total suspended particulate	10	24 hours
Sulfur dioxide	13	24 hours
Lead	0.1	24 hours
Mercury	0.25	24 hours
Beryllium	0.0005	24 hours
Fluorides	0.25	24 hours
Vinyl chloride	1.5	24 hours
Total reduced sulfur	10	1 hour
Hydrogen sulfide	0.04	1 hour
Reduced sulfur compounds	10	1 hour
Ozone	Increased emissions of less than 100 tons per year of volatile organic compounds	

Source: Arizona Administrative Rules and Regulations, Title 18-Environmental Quality; Chapter 2-Air Pollution Control, Article 3; Permits.

C.3.1 Existing Conditions

The Office of Air Quality Control, Department of Environmental Quality (formerly the Bureau of Air Quality Control, Division of Environmental Health Services, Arizona Department of Health Services) monitored the carbon monoxide and ozone concentrations in Sierra Vista from 1977 through 1983. Carbon monoxide is emitted primarily by vehicles, and ozone is a product of photochemical reactions involving hydrocarbons and nitrogen oxides that are emitted primarily by vehicles. Carbon monoxide is a problem primarily during the winter months and ozone is a problem primarily during the summer. The state monitoring program was discontinued in 1984. The monitoring results were reported as the highest and second highest 1-hour and 8-hour CO averages and the highest and second highest 1-hour O_3 averages, by year for the entire year. The results were well below primary and secondary standards for ambient air, and even seemed to exhibit a decreasing trend. The decrease probably was caused to a great extent by the gradual replacement of older vehicles with newer, cleaner models. That trend was expected to continue. Population projections indicated that the likely rate of population increase would be more than offset by decreases in average vehicular emission rates at least through 1988, and it was argued that the trend toward reduction in CO and O_3 concentrations probably would continue through 2000. With this justification, the routine monitoring program for CO and O_3 in Sierra Vista and several other Arizona cities was discontinued in 1984. While the monitoring program was in operation, none of the values measured in Sierra Vista exceeded the primary or secondary standard for either of these pollutants.

The Office of Air Quality Control has also monitored total suspended particulate matter (TSP) in Sierra Vista. The data are reported by year, and the reported quantities are the annual mean TSP, the highest and second highest values observed during the year, and the number of exceedances of then-current primary and secondary 24-hour averages. From 1974 through 1988, the last year for which data are available, the federal

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primary 24-hour standard was exceeded once in each of 2 years, and the federal secondary 24-hour standard was exceeded once in each of 3 years, and twice in another year. All of the annual averages were below the then-current primary annual standard but during 3 years, the secondary annual standard was exceeded. All of the exceedances occurred before 1980, and the values since have generally been noticeably smaller than the pre-1980 values.

The federal and Arizona primary and secondary standards for particulates are now expressed in terms of PM_{10}, i.e., the total mass per cubic meter of particles with an aerodynamic diameter of 10 μm or smaller. Particles in this size range are of greater significance to human health because they are respirable. Because PM_{10} is a component of TSP, a measurement of TSP will always exceed a measurement of PM_{10}. The U.S. Environmental Protection Agency has published a report that helps to assess the likelihood that the PM_{10} standard would be exceeded on a daily basis from measurements of TSP (EPA 1986b). The methods presented in this report were applied to the Sierra Vista TSP data. The analysis indicated that the area covered by the measurements was in PM_{10} attainment at the time of the measurements.

The observation of a decreasing trend in the TSP concentration is interesting. Arid areas of the southwestern United States commonly exhibit high particulate concentrations. Natural wind erosion processes are a major source, and unpaved roads are another large contributor. Available climatological records were examined to see if weather patterns could account for the apparent trend. The Army at Fort Huachuca maintains records of routine weather observations as far back as 1956. Temperature, precipitation, and wind speed and direction data are available, and most of the data have been averaged over periods that are appropriate to look for trends that might correlate with the observed TSP trend. There are no trends apparent in these averages that would seem to correlate with the declining trend in the particulate data. A possible explanation for the trend is that the monitoring location was influenced by nearby dirt roads that have since been paved or by construction projects that have been completed. In light of the steady growth in the Fort Huachuca-Sierra Vista area, this explanation is plausible. As is always the case in arid regions, areas of blowing dust during windy periods are fairly common and can cause localized high particulate concentrations.

Vehicles are probably the most significant source of nitrogen oxides at Fort Huachuca followed by aircraft. Space heating during the winter, backup diesel generators, and other sources also release smaller amounts of nitrogen oxides. Although an aircraft such as an F-16 practicing 'touch-and-go' operations produces fairly large quantities of nitrogen oxides and other pollutants, much of the material is released well above ground level and so would be highly diluted by the time it reached a ground-based sensor. In light of the fact that the Arizona Office of Air Quality Control determined that certain other contaminants released predominantly by vehicles would be unlikely to exceed air quality standards in the area, it is also unlikely that the concentration of nitrogen oxides would exceed federal or Arizona standards.

At Fort Huachuca, sulfur oxides could be released by internal combustion engines (vehicles and aircraft), boilers and other heating equipment, and certain military ordnance that might be used in training programs.

Present fuel formulations for internal combustion engines are quite low in sulfur, as are the boiler and heating fuels that are used at Fort Huachuca (natural gas, propane, and fuel oil). Likewise, the propellants for the barreled-weapons that are used in training at Fort Huachuca are of necessity low in sulfur to minimize corrosion. Therefore, the activities covered by this document are not expected to contribute measurably to the background sulfur oxides level but again, the transport from nearby non-attainment areas is a possible source.

Meteorological and climatological data have been obtained from the TEXCOM Meteorological Team at Fort Huachuca. These data have been used to establish representative wind scenarios for the dispersion modeling, to estimate the annual number of days with rainfall for the purpose of estimating fugitive dust production on unpaved roads, and for other modeling-related computations.

All of the available information indicates that the ambient air at Fort Huachuca meets applicable federal and Arizona air quality standards for annual and shorter term average concentrations of contaminants. The effects on air quality of the activities and programs will be investigated in the following section in order to establish the degree of degradation that would result from the proposed action and alternatives.

C.3.2 Activity Levels

Baseline information on the official activity levels at Fort Huachuca have been extracted from a variety of sources. Earth Technology Corporation (1993) conducted an inventory of stationary sources of air pollutants that was published in 1993. An update was published in 1994. This document provided valuable information on the quantities of pollutants released by the activities. That information was used as the basis for air dispersion modeling to estimate the concentrations of pollutants under various conditions and to evaluate those concentrations against various air quality standards presented above. Possible expansion of facilities and programs was considered. Information on motor vehicles was obtained from the post vehicle registration office and from discussions with government and contractor personnel with knowledge of vehicle assignment and usage associated with official programs. Information on aircraft usage was obtained from the Chief of Air Traffic Control at Libby Army Airfield. That information was used as the basis for estimating the total quantities of concentrations of pollutants. Information on individual programs, especially programs for which expansion is planned, was obtained from personnel associated with those programs and from program documents.

C.4 ENVIRONMENTAL EFFECTS

The nature of the Proposed Action alternative is planning and no potential adverse air quality impacts are attributable to this planning action. The following discussion serves as a baseline evaluation of noise across the installation.

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Ongoing activities at Fort Huachuca release criteria and toxic air pollutants. These releases must be examined in the context of the Arizona and federal laws and regulations that pertain to air contaminants. Both the quantities of pollutants released and the concentrations that result must be investigated to ensure compliance. Investigation of concentrations usually requires the use of dispersion modeling.

C.4.1 Contaminants Released by Stationary Sources

A comprehensive inventory of stationary air pollution sources at Fort Huachuca was published by Earth Technology Corporation (1994). The categories of sources covered in the investigation and the quantities of criteria pollutants and hazardous air pollutants released by them are listed in Table C-4. The inventory considered both the hazardous air pollutants listed in the Clean Air Act Amendments, and chemicals emitted into the air that are regulated under the Superfund Amendments and Reauthorization Act. The inventory covered all major stationary sources except motor pools, open detonation of explosives, and firing ranges. Order of magnitude estimates are made in this document of the quantities and concentrations of air pollutants resulting from firing ranges and explosives. The inventory covered air pollutant releases for the year 1993. For 1994, emissions were very similar.

Table C-4. Fort Huachuca Air Emission Inventory for Calendar Year 1993

	Total Annual Emissions Of Criteria Pollutants (Tons)	Maximum Pollutant And Amount (Tons)	Total Annual Emissions Of Hazardous Air Pollutant (Lbs)	Maximum Pollutant And Amount (Lbs)
Boilers	23.56	NO_x 17.38	84.7	80.4 Formaldehyde
Incinerators	0.49	0.15 CO, NO_x	1397	1386 Hydrogen chloride
Electric generators	6.37	4.43 NO_x	7.0	2.8 Formaldehyde
Miscellaneous heating	18.33	11.26 NO_x	250.9	250.7 Formaldehyde
Fuel storage & dispensing	8.45	8.45 VOC[1]	2655	1060 Toluene
Paint spray booths	13.61	13.22 VOC	1982	589.7 Methyl ethyl ketone
Degreasing	3.23	3.23 VOC	193.8	32.3 Ethyl benzene, Perchloroethylene, Toluene, and 1,1,1-Trichloroethane
Woodworking	0.56	0.56 PM_{10}[2]	0	0
Fugitive volatile organic compounds and hazardous air pollutants (such as from painting)	4.48	4.14 VOC	4724	2702 Methyl ethyl ketone
Pesticides and herbicides	6.22	6.22 VOC	308.3	229.4 Xylene
Wastewater treatment	5.46	5.46 VOC	72.5	72.5 Chloroform
Landfills	7.64	7.64 VOC	0	0
Welding	0.04	0.04 PM_{10}	0	0
Laundry and dry cleaning	3.25	3.24 VOC	6480	6480 Perchloroethylene
Printing	0.94	0.94 VOC	40.5	25.3 Perchloroethylene
Abrasive blasting	0.01	0.01 PM_{10}	0	0
TOTALS	**102.51**		**18,196**	

1. VOC = volatile organic compounds.
2. PM10 = particulate matter smaller than 10 μm in diameter.

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The source categories identified in the above table were examined in more detail. The EPA screening model, SCREEN, was used to estimate downwind concentrations resulting from these air contaminant releases (EPA 1991). SCREEN has been designed to find the worst-case concentration and the meteorological conditions under which it would occur and the concentration at user-specified downwind distances. In all cases, normal variability in wind direction would greatly reduce actual concentrations averaged over periods of minutes or longer. In actual operation, a concentration predicted by SCREEN would correspond most closely to the highest instantaneous concentration observed with a downwind sensor. As the wind causes the plume to move back and forth across the sensor, the instantaneous measured concentration would vary between background and the maximum. Many of the contaminant sources examined here do not operate during the entire day. When appropriate, concentrations that apply to periods of 24 hours or longer are averaged accordingly. In addition, conservative modeling assumptions were made in all cases. For example, when pollutants are removed from a facility with an exhaust ventilation system, conservative estimates were used for the air flow rate, the height of the stack, and the temperature of the exhaust flow relative to the ambient air. Predicted concentrations are summarized in Table C-5.

C.4.2 Contaminants Released by Mobile Sources

Contaminants released by mobile sources are spatially dispersed over a large area. The dispersion modeling tools required to investigate mobile source pollutants are different from those required for stationary sources.

C.4.2.1 Ground Vehicles

Motor vehicles produce a number of air contaminants. Their internal combustion engines release carbon monoxide, nitrogen oxides, hydrocarbons (including methane), sulfur oxides (if the fuels contain sulfur), and particulates. In addition, the mechanical and aerodynamic effects of a vehicle on a road surface produce fugitive dust. Fugitive dust can be the dominant contaminant when vehicles are operated off-road or on dirt roads. The method to predict the effects of vehicles on air quality preferred by the Environmental Protection Agency (EPA 1986a) is to determine the initial distribution of contaminants and then to use dispersion modeling to predict the concentrations at specific points. The initial distribution usually can be preferred dispersion calculated using emission factors, traffic volume, and vehicle characteristics. The EPA-model for air contaminants originating from motor vehicles is one of the members of the CALINE family of models. The CALINE models were developed by the California Department of Transportation (Benson 1979). CALINE3 is the third generation of refinement and it was used here. It has been ported to many different computer platforms.

In the absence of comprehensive traffic counts broken down on an hourly basis for all major roads at Fort Huachuca, reasonable estimates were developed based on available data. Conservative emission rates were assigned taking into consideration vehicle type, speed, and acceleration from signal devices.

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The Fort Huachuca Master Plan Narrative (Zillgens 1991b) was used to identify primary and secondary roads. For modeling purposes, most of the daily traffic was assumed to be confined to roads in these 2 categories. This assumption results in conservative estimates of the maximum contaminant concentrations at roadside along the primary and secondary roads. Most of the conclusions in this section are based on the maximum roadside concentration, so the modeling approach is intrinsically conservative. The installation workforce, their place of residence, and the post population were used to estimate the total number of vehicles in use for commuting and for personal transportation during the work day. Privately-owned vehicle registration data provides an exaggerated estimate of traffic volume because the number of registered vehicles far exceeds the combined civilian and military work force. Very conservative assumptions were made on the number of vehicles and how and when they are used.

Table C-5. Predicted Maximum Air Contaminant Concentration Based on Emission Inventory For 1993.[1]

	Major Criteria Pollutants	Predicted Maximum Concentration	Major Hazardous Air Pollutants	Predicted Maximum Concentration
Boilers	No_x CO	5.1 $\mu g/m^3$ 1.1 $\mu g/m^3$	Formaldehyde	0.012 $\mu g/m^3$
Incinerators	No_x SO_2 Pb	8.4 $\mu g/m^3$ 2.6 $\mu g/m^3$ 0.067 $\mu g/m^3$	Hydrogen chloride	49 $\mu g/m^3$
Electric Generators	NO_x	20 $\mu g/m^3$	Propylene formaldehyde	0.013 $\mu g/m^3$ 0.0059 $\mu g/m^3$
Miscellaneous heating	No_x CO	0.85 $\mu g/m^3$ 0.36 $\mu g/m^3$	Formaldehyde	0.00951$\mu g/m^3$
Fuel storage and dispensing	VOC[2]	5.0 mg/m^3	Toluene	0.76 mg/m^3
Paint spray booths	VOC PM_{10}[3]	4.0 mg/m^3 0.11 mg/m^3	Xylene Methyl ethyl ketone	0.096 mg/m^3 0.063 mg/m^3
Degreasing	VOC	1.5 mg/m^3	Xylene Ethyl benzene Perchloroethylene| Toluene 1,1,1- trichloroethane	0.015 mg/m^3 0.0075 mg/m^3 0.0075 mg/m^3 0.0075 mg/m^3 0.0075 mg/m^3
Woodworking	PM_{10}	0.01 mg/m^3	0	0
Fugitive volatile organic compounds and hazardous air pollutants (such as from painting)	VOC	Negligible	Methyl ethyl ketone	Negligible
Pesticides and Herbicides	VOC	Negligible	Xylene	Negligible
Wastewater treatment	VOC	Negligible	Chloroform	Negligible
Landfills	VOC	0.1 mg/m^3	0	0
Welding	PM_{10}	Negligible	0	0
Laundry and dry cleaning	VOC	4.3 mg/m^3	Perchloroethylene	4.3 mg/m^3
Printing	VOC	1.2 mg/m^3	Perchloroethylene Triethylene glycol	0.016 mg/m^3 0.016 mg/m^3
Abrasive blasting	PM_{10}	Negligible	0	0

1. All predicted concentrations are within industrial hygiene standards for workplace exposure at locations near the release point, and within air quality regulations at points more than 500 m from the source.
2. VOC = volatile organic compounds
3. PM_{10} = particulate matter smaller than 10 μm in diameter

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The more important traffic arteries were identified on a Fort Huachuca map, and reasonable traffic flow rates were assigned to each based on the proximity to important destinations. Contaminant predictions were computed for selected locations throughout the installation. Modeled locations included several major intersections, residential areas, schools, the hospital, the commissary, and recreational and training areas. The predicted concentrations of pollutants at any specific location depend on the meteorological conditions, and in particular on the wind speed and direction. For example, the concentration is much higher on the downwind side of a road compared with the upwind side. A comprehensive set of modeling scenarios was developed. These scenarios included low and moderate wind speeds, a full range of wind directions, and conservative values for the mixing height. In all, concentrations were predicted for 20 locations at 3 different wind speeds and 8 different wind directions for a total of 480 separate predictions. The results of the modeling for carbon monoxide are that the highest expected roadside concentration under the most unfavorable wind conditions would be 16 mg/m^3. For locations away from major roads or intersections, the highest concentration would be 3.1 mg/m^3. For higher wind speeds, concentrations would be much smaller. Even under the most conservative modeling scenarios, the predicted concentrations of carbon monoxide are well below the one-hour federal and Arizona Primary Ambient Air Quality Standards at all modeled locations. Only at major intersections does the predicted concentration exceed 8% of the Ambient Air Quality Standards. Because traffic is much lighter during most of the work day than at the peak commuting periods that were used as the basis for the modeling, the average concentrations of carbon monoxide over the work day would be much smaller than the values reported in Table C-5. It should be noted that the highest values predicted for the concentration of carbon monoxide, which correspond to roadside locations, are consistent with the highest 1-hour average values that were recorded during the Arizona monitoring program.

The federal and Arizona Primary and Secondary Ambient Air Quality Standards for nitrogen oxides are based on the annual average. Nitrogen oxides are released by gasoline-fueled vehicles at a rate typically less than one-tenth the rate of carbon monoxide. Assuming that the traffic flow rate is 25% of the peak commuting rate during the work day and 10% during the remainder of the weekdays and all day on weekends, the maximum concentration of NOx at any of the modeled locations would be 260 μg/m^3 if the most unfavorable wind conditions persisted over the entire year. When averaged for wind speed and direction, the average concentration would be no more than one tenth of this value which is well below the standard of 100 μg/m^3. At those locations not adjacent to major intersections, the maximum concentration would be a factor of 7 smaller. Similar analyses indicate that the concentrations of particulates and sulfur oxides resulting from motor vehicles would be well within federal and Arizona Ambient Air Quality standards.

C.4.2.2 Aircraft

Aircraft operating from Libby Army Airfield (LAAF) at Fort Huachuca release substantial quantities of air contaminants. The airfield is also used by civil aircraft. Detailed operational statistics for 1992, 1993, and 1994 were examined. During this period, total operations were highest in 1992. In 1993, a staffing shortage resulted in a reduction in the hours of operation of LAAF Air Traffic Control. In 1994, reconstruction of the main runway was begun. The Arizona Air National Guard (ANG) Field Training Site Master Plan projects aviation activity through the Year 2010. As discussed below, the effects of expected expansion in aircraft operations were estimated by considering known expansion plans and by using the ANG projections for general traffic. For the general traffic projection, the 1992 mix of traffic was proportionally increased to the projected Year 2000 number of operations. The Environmental Protection Agency publishes detailed information that can be used to estimate the quantity of air contaminants released by aircraft during normal operations (EPA 1990). The information includes air pollutant emission factors for carbon monoxide, nitrogen oxides, total hydrocarbons, sulfur oxides, and particulates in pounds per hour for 4 engine power settings (3 for helicopters) commonly used in the take-off/landing cycle. Data are provided for both civil and military engine types. Typical take-off/landing cycle times are also provided for Navy and Air Force fixed-wing aircraft, for military helicopters, and for civil aircraft. To simplify calculations, EPA provides emission factors for complete take-off/landing cycles for many common aircraft types.

LAAF is frequently used by aircraft from other bases for "touch-and-go" training operations. In a touch-and-go, a pilot makes a normal landing approach, momentarily touches the landing gear to the runway, applies take-off power, and executes an essentially normal take-off. There is no ground idle or taxi time and so smaller quantities of pollutants are released compared with a normal cycle. For many engine types, carbon monoxide and hydrocarbon emission rates are highest during taxiing and ground idle. Most of the operations involving Navy and Air Force fighter and ground attack aircraft are actually touch-and-go exercises. Calculations of total quantities of emitted pollutants were based on the assumption that 90% of the operations of F-16, A-10, F-18, and F-14 aircraft are touch-and-go. All other operations, including those of large transport aircraft and helicopters, were assumed to include all phases of the cycle.

The total air emissions by aircraft during 1992 during phases of their operations that could be considered to take place at Fort Huachuca are summarized in Table C-6. It should be noted that an operation is a take-off or landing and that a single touch-and-go is counted as 2 operations. A complete take-off/landing cycle as used in the EPA (1990) tables likewise accounts for 2 operations. The major difference between an operation involving a local aircraft and a transient aircraft is that the local aircraft takes-off and completes the cycle (in the EPA sense) when it lands, while a transient aircraft lands and completes the cycle when it takes off. The EPA methodology attributes emissions between the beginning of approach and end of climb-out to the local airfield.

In order to estimate the concentrations of pollutants resulting from aircraft, air dispersion modeling was used. Two distinct situations were considered: aircraft parked with idling engines, and aircraft in motion including taxiing, take-off and landing rolls, climbout, and approach.

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Table C-6. Estimated Annual Air Emissions by Aircraft During Landing, Take-Off, and Ground Operations at Fort Huachuca for the Year 2000

Pollutant	Quantity (tons)
Carbon monoxide	423.3
Nitrogen oxides	112.0
Hydrocarbons	61.8
Sulfur oxides	8.6
Particulates	9.8
Total	**615.5**

Using EPA data, the highest emission rate of any criteria pollutant from the aircraft types at LAAF while the engines are idling is 61.8 kg per hour of CO combined from the 2 engines of an F-14. The INPUFF dispersion model was used to estimate the downwind concentration of carbon monoxide that would result from these circumstances. The INPUFF model was selected for this purpose because it allows the user great versatility in defining the modeling conditions. The model results indicate that the steady-state concentration of carbon monoxide would not exceed 39.8 mg/m^3 at any point 10 m or more downwind from the aircraft. This concentration is well below the ACGIH-recommended thirty-minute exposure limit of 87 mg/m^3 for workplace exposure. Assuming that idle time would not exceed 10 minutes, the one-hour average CO concentration at any 1 point would not exceed 6.6 mg/m^3 which is well below the ACGIH-recommended 8-hour time-weighted average threshold limit value of 29 mg/m^3. Thus, for normal flight operations, there is little likelihood that workplace exposure would reach the ACGIH limit. If maintenance required extensive ground idle time, however, the workplace exposure level could reach the ACGIH limit under steady, light wind conditions. The concentration of contaminants in the air would drop off rapidly with distance from the aircraft. At a downwind distance of 100 m, the predicted concentration is less than one third the value at 10 m. Beyond 500 m, the predicted concentration is not elevated above the background.

When aircraft are in motion, pollutants are more widely dispersed. During a single take-off, the engines are started and operated at idle or low power during preflight checks. The aircraft taxis to the end of the runway at low power, and takes-off and climbs-out at high power. During landing, the aircraft approaches from the direction opposite the take-off direction (assuming no major wind direction changes), touches down, rolls out some distance, and taxis to its designated parking place. In the EPA approach, pollutants are considered to be local to the airfield from the beginning of the approach phase to the end of the climb-out phase. Ground operation and the take-off and climb-out are responsible by far for the largest part of the pollutants. Therefore, the modeling was conducted by assuming that all of the pollutants are released from the end of the runway (beginning of the take-off roll) to the end of the climb-out. It was further assumed that the average speed is 200 kts (230 mph) which is typical of tactical military aircraft that account for the largest share of the pollutants. The duration of the climbout was taken to be 0.8 min as taken from EPA (1990).

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The concentrations of air pollutants were predicted using the line source model CALINE3 (Benson 1979). Release rates per mile were computed as described above. The entire release was assumed to occur at a height of 2 m above ground, and all aircraft operations were assumed to occur during a twelve-hour interval 6 days per week. The results are presented in Table C-7.

Table C-7. Estimated Concentrations of Air Contaminants Resulting from Aircraft Operations

Pollutant	Maximum 1-Hour Average Concentration (μG/M³)		
	At runway (very light parallel wind)	100 m from runway (very light diagonal wind)	500 m from runway (very light diagonal wind)
Carbon monoxide	3,085.0	671.0	134.0
Nitrogen oxides	995.0	216.0	43.3
Hydrocarbons	541.0	117.0	23.5
Sulfur oxides	76.0	16.5	3.32
PM_{10}	87.4	19.1	3.82

Beyond the immediate vicinity of the runway, i.e. beyond 500 m, the predicted maximum concentrations are well within federal and Arizona Ambient Air Quality Standards, and the increases in the concentrations of pollutants, when averaged over appropriate averaging times, are within applicable increments for Class II attainment areas. Over the course of a year, actual average concentrations would be much lower because of variation in wind speed and direction.

C.4.2.3 Military Ground Vehicles

Military training and testing programs sometimes involve using vehicles on- and off-road. These vehicles release normal engine emissions, and when operated on unpaved roads, also generate fugitive dust as a result of the action of tires or treads on the ground.

One vehicle maneuvering activity proposed by the AZ Army National Guard involves off-road vehicle usage of the E Troop 118th. Activities of E Troop, 118th would be similar to those of the former 8th/40th which were once stationed at Fort Huachuca but have since been deactivated. The analysis of air quality effects was conducted using previous information appropriate for the 8th/40th. This approach ensures that the results are very conservative and serve as an upper bound on the air quality effects of armored vehicle training at Fort Huachuca. The annual air emissions of the 8th/40th were estimated to be 1.3 tons of carbon monoxide, 10.2 tons of nitrogen oxides, 0.5 tons of hydrocarbons, and 0.1 ton of sulfur oxides. The emission of fugitive dust is treated very superficially in COE (1994). The methodology used elsewhere to estimate fugitive dust emissions from vehicles on unpaved roads in semi-arid regions lead to estimates of about 1.7 pounds per mile for 4-wheel light vehicles up to 13.2 pounds per mile for 18-wheel heavy trucks (Department of the Army 1991). Tracked vehicles are known to generate more dust than wheeled vehicles of comparable weight, so

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an estimate of 25 pounds per mile is reasonable under dry soil conditions. Using these emission factors and the vehicle usage data in COE (1994), the annual production of fugitive dust would be about 250 tons.

Far more important than the quantity of dust emitted is the concentration. Because training exercises tend to spread activity over a fairly large area, the concentrations of the gaseous pollutants would be fairly small except within or very near the exhaust plume of a vehicle. Emission rates per vehicle are far smaller than those of aircraft which were shown above to be below levels of concern. Dust releases by tanks, however, are higher and should be examined in more detail. The dust level in the immediate vicinity of a tank could easily exceed the ACGIH and OSHA limits for workplace exposure. Maneuvering of multiple tanks can be treated as an area release. If 14 tanks are assumed to be operating within a 0.5-km square area, each emitting dust at the rate of 25 pounds per mile, the worst case downwind dust concentration can be estimated with SCREEN. Under very light wind conditions, the predicted downwind concentrations are as high as 3 mg/m^3 at 5 km downwind and 1.3 mg/m^3 at 10 km downwind. These estimates neglect settling, and, assume steady release. When averaged over an entire year, and over the natural variation in wind direction and speed, the concentrations are likely to be at least a factor of 100 smaller than the worst case concentrations, and would be well within the allowable increment for a Class II Attainment Area at a distance corresponding to the distance from the maneuver area to Sierra Vista. Because training would normally occur for only 38 days per year, averaging over time alone would reduce the average concentration by a factor of nearly 10.

It is important to note that activities involving the maneuvering of tank vehicles associated with the E/118th are being addressed under separate NEPA documentation (where the AZ Army National Guard is the proponent) and are not considered to be a part of the operational baseline for Fort Huachuca.

C.4.2.4 Construction Activities

Construction of buildings and other facilities at Fort Huachuca are temporary and unlikely to cause major increases in pollution levels. For example, vehicles associated with construction projects would be far smaller in number than the thousands of privately-owned and hundreds of official vehicles used at Fort Huachuca every day. Fugitive dust raised by construction activities would be highly localized and of short duration. The contaminants would rapidly disperse. The effects would be negligible except in the immediate vicinity of the activity.

C.4.2.5 Facilities Maintenance and Groundskeeping Activities

The total release of contaminants by activities considered in previous studies are listed in Table C-9. It was concluded in those studies that the quantities and concentrations of contaminants are inconsequential. Although no major increases in these types of activities are expected over the next 5 years, even if the activities were to double, the quantities and concentrations would be inconsequential.

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Table C-9: Estimated Annual Quantities of Air Contaminants Released by Facilities Maintenance and Groundskeeping Operations.

	Carbon Monoxide	Nitrogen Oxides	Hydro-carbons	Sulfur oxides	Exhaust particulates and fugitive dust
Totals	**7.2 tons**	**7.9 tons**	**4.9 tons**	**0.76 tons**	**4.5 tons**

C.4.3 Summary

In aggregate, approximately 103 tons of criteria air pollutants and 9 tons of hazardous air pollutants would be released by stationary sources each year at Fort Huachuca. Extensive modeling was used to demonstrate that the concentrations of these pollutants would rapidly be dispersed, and their concentrations, except, in some cases, in the immediate vicinity of the source, would not exceed recognized standards for workplace exposure or federal or Arizona Ambient Air Quality Standards or concentration increments for Class II Attainment Areas.

The most important categories of mobile sources of air contaminants release far larger quantities than stationary sources. For example, aircraft operating from Libby Army Airfield annually release approximately 615 tons of criteria pollutants, primarily carbon monoxide, nitrogen oxides, and hydrocarbons. Operation of armored vehicles would release less than 250 tons of fugitive dust annually. Operation of privately-owned, government, and contractor vehicles at Fort Huachuca, for commuting, other personal use, and official use would release substantial quantities, although the quantities were not estimated. Extensive modeling was performed to estimate the concentrations of pollutants that would result from mobile sources. The results of this modeling are that except in the immediate vicinity of the sources, the concentrations would not exceed workplace exposure limits, federal or Arizona Ambient Air Quality Standards or concentration increments for Class II Attainment Areas. Projected new programs would not result in concentrations exceeding these levels.

Because the facilities and activities at Fort Huachuca are spread throughout the installation, and because concentrations from individual facilities and activities are generally much smaller than Ambient Air Quality Standards and concentration increments, it is unlikely that cumulative concentrations would reach levels of concern.

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APPENDIX D NOISE INVESTIGATION

D.1 INTRODUCTION

This appendix is a systematic examination of the existing noise environment at Fort Huachuca. The nature of the Proposed Action alternative is planning and no potential adverse noise impacts are attributable to this planning action. The following discussion serves as a baseline evaluation of noise across the installation.

D.1.1 Measurement Units

Sound levels are customarily measured in decibels (dB). The dB is a logarithmic unit because the response of the human ear to varying levels of sound energy closely follows a logarithmic relationship. The perceived sound level (loudness) is directly related to the logarithm of the amount of energy carried by the wave. Each 10 dB increment represents a factor of 10 in energy. Thus, a sound wave of 80 dB intensity carries 10 times as much energy as a sound wave of 70 dB. Addition of sound levels must be done by converting to an energy basis, adding, and then converting back to decibels. Thus, 2 sounds of 80 dB produce an additive effect of 83 dB, not 160 dB.

The terminology and units used in noise measurements can be a source of confusion to people not experienced in the field of acoustics. Some knowledge is helpful in assessing the background noise .

D.1.2 Weighting Scales

The perceived pitch of a sound is related to the frequency of vibration of the source which is the same as the frequency of vibration of the air molecules that transmit the sound. The human ear is generally considered to be sensitive to sounds within the frequency range from 20 Hertz (vibrations per second) to 20,000 Hertz, but it is not equally sensitive to all frequencies. For example, a sound wave of frequency 3,000 Hz with a given energy content is perceived to be much louder that a 100-Hz sound with the same energy content. In order to correct for this effect, weighting scales have been adopted.

The A-weighting scale is the most commonly used. It was designed to correct for the auditory sensitivity of the human ear. This scale approximates the relative noisiness of different sounds. Sound levels measured with A-weighting are abbreviated dBA.

The C-Weighting scale approximates the response of the human ear to sound pressure level. It is often used in dealing with intense sounds such as explosions. Sound levels measured with C-weighting are abbreviated dBC.

For impulsive sounds, the unweighted sound pressure level (SPL) is often used. It is the ratio expressed in dB of the peak impulsive overpressure to the standard reference level of 20 micropascals (0.00000042 pounds per square inch).

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D.1.3 Meter Time Response

Sound level meters generally exhibit an exponential time-weighted response. This means that a meter inherently averages over time, and thereby reduces short-term fluctuations in the observed level. Measurements are usually made with the meter set for either a "fast" or "slow" response. Fast and slow have standardized meanings. The time constant of a measuring device is 125 milliseconds for fast response, and 1 second for slow response. In both cases, the measuring circuitry is designed so that the rise and fall times are equal. Slow response is appropriate for many common noise sources such as aircraft and traffic, and is specified in many noise exposure standards.

For short duration sounds, "impulse" response may be appropriate. Impulse response of a sound meter is defined as an exponential rise time of 35 milliseconds and a fall time of 1.5 seconds. The long fall time allows the operator sufficient time to observe the transient meter reading. Impulse response would be appropriate to assess the human perception of acoustic events such as explosions. The duration of the impulsive sound from an explosion or gunfire is typically in the range from a few milliseconds to a few tens of milliseconds depending on the size of the explosion, the distance to the location of the observer, and other factors. Impulse measurements are useful in comparing the perceived loudness of different impulsive sounds, but they cannot readily be compared with fast or slow average measurements of steady sources. For example, a steady 90-dB sound level would render conversation difficult. A 90-dB impulsive sound of 10 millisecond duration would have minimal effect on conversation although it would be readily noticed and probably would cause a startle reaction or disturb sleep. The peak level from an impulsive sound is not detected by a slow response meter. However, the energy it carries contributes to the total energy detected by the meter and therefore, it intrinsically affects measurements of equivalent sound levels made with a slow response meter.

D.1.4 Attenuation

Sound emanating from a small source is reduced in intensity as it propagates. There are 2 types of attenuation that usually must be considered in noise assessments: geometric divergence and atmospheric absorption.

Geometric divergence results from the fact that as sound energy propagates away from the source, it fills an ever increasing volume of space. For the common situation in which the source is small compared with the distance away, the sound energy decreases as the square of the distance. Thus, the intensity of the sound measured at a distance of 200 ft is one-fourth the intensity measured at 100 ft. Because the dB scale is logarithmic, the sound level would decrease by 6 dB for each distance doubling. For another common situation in which the source of sound can be represented as a line (such as a road carrying steady traffic), the intensity is inversely proportional to the distance. Thus, the intensity at 200 ft is one-half the intensity at 100 ft which corresponds to a 3 dB drop.

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Atmospheric absorption is the reduction in intensity because of conversion of sound energy to heat energy. For sound of a fixed frequency, the sound level is reduced by a fixed amount per unit propagation distance. Thus, if the reduction is 7 dB in 1 mile, it will be 14 dB in 2 miles. The level of absorption depends on the frequency of the sound and on the air temperature, pressure, and relative humidity. High frequency sounds are much more strongly absorbed than low frequency. For example, a 4000 Hertz sound would be reduced in level by 109 dB by propagation over 1 km at a temperature of 68 degrees Fahrenheit, 1 atmosphere pressure, and 10% relative humidity. Under the same conditions, a 125 Hz sound would be reduced by only 0.78 dB. Thus, a high frequency sound would become inaudible while a low frequency sound would be barely reduced. Impulsive sounds such as those resulting from explosions and large bore weapons fire tend to be rich in low frequencies and so not strongly attenuated by atmospheric absorption.

Sound propagation, especially long range sound propagation, is affected by wind. Propagation with little or no wind is the case predicted by the inverse square scaling. Propagation in the same direction as the wind tends to cause sound waves to stay near the ground and result in relatively high ground-level intensity. Propagation into the wind tends to cause the sound waves to refract upward and result in relatively low ground-level intensity.

D.1.5 Characterization of Variable Sounds

The equivalent sound level for a given period of time is defined as the level of a constant sound that would have the same energy as the real, time-varying sound over the same period, and is thus the average computed on an energy basis. Equivalent sound levels are understood to be computed from A-weighted levels. The day-night average sound level is a 24-hour equivalent sound level in which sound levels that occur between 2200 (10 PM) and 0700 (7 AM) are increased by 10 dB over their actual values. The purpose of this penalty is to correct for the fact that noises are more likely to cause annoyance in exposed communities if they occur during the nighttime hours when a substantial fraction of the population is sleeping.

D.2 THE EXISTING ENVIRONMENT

The most recent investigation of the noise background in the area was the Environmental Noise Management Plan and Installation Compatible Use Zone Survey conducted in 1997 by the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM 1997).

D.2.1 Installation Compatible Use Zone Survey

The noise level at Fort Huachuca and nearby communities was studied in detail in the preparation of the Fort Huachuca Envirmental Noise Management Plan and Installation Compatible Use Zone (ICUZ) survey that was completed in 1997. Data from this report was obtained during 1992. Monitoring was conducted at 7 sites in Sierra Vista, 3 sites in Huachuca City, and 4 sites within Fort Huachuca, 2 near Libby Army Airfield and 2

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near Hubbard Airfield. Fort Huachuca sites were selected near Libby and Hubbard Airfields because aircraft were expected to be the major contributor to the noise background.

At each site, for 1 week during July and another week during September, equivalent sound levels were measured during the day and during the night, and the day-night average sound levels were computed. The ICUZ measurements were conducted with the measuring instruments adjusted for slow response. All sampling was conducted at the rate of 4 samples per second, but the raw values were averaged over 10-minute periods to provide 10-minute equivalent sound levels. These values were subsequently used to compute equivalent sound levels for the daytime and nighttime periods, and also day-night average sound levels. As discussed above, impulsive sound levels such as those that arise from weapons firing or from detonation of explosive projectiles have a fast rise time and brief duration. The peak levels from such sounds were not detected by the slow response meter used in the ICUZ survey. The energy of impulsive sounds did contribute to the total energy detected by the meter and to the computed equivalent sound levels, but the ICUZ measurements do not provide an adequate basis to assess community response to weapon noise. The results of the ICUZ noise measurements are summarized in Table D-1.

Examination of the summary noise survey results shown in Table D-1 reveals some interesting results. With the exception of Sierra Vista Site 4 and Huachuca City Site 1, the off-post monitoring sites exhibited much lower noise levels than the sites near the Fort Huachuca airfields. The readings at Sierra Vista Site 4 and Huachuca City Site 1 were thought by the survey team to be anomalous, and probably can be discounted. The U. S. Environmental Protection Agency (EPA) has set a goal of achieving day-night average sound levels of 55 dBA for residential areas. Two of the 3 Huachuca City sites and 1 Sierra Vista site have mean values below 55 dBA. The other off-post sites are above 55 dBA, but with the exception of the 2 potentially anomalous sites, the averages are only slightly above 55 dBA (from 0.2 to 2.2 dBA). For noise of 1,000 Hertz bandwidth, a typical listener can barely detect differences in sound pressure level of 2 dBA. Thus, most of the differences between the actual day-night average values and the 55 dBA level would not be noticed by most observers.

A detailed examination of the raw monitoring data reveals that most but not all of the off-post monitoring sites have a distinct diurnal variation with a noise peak between 0600 and 0700 (6 and 7 AM) and another peak between 1800 and 1900 (6 and 7 PM). This behavior indicates that the dominant noise source at those sites is vehicular traffic. Vehicular traffic is at its highest level during the morning and evening commuting periods. Some of the off-post sites have a higher and relatively constant noise level from 0800 to 1800 (8 AM to 6 PM) than at other times during the day. Noise at these sites is dominated by commercial activities such as delivery vehicles. Many of the measurements show brief high intensity events mainly during the daytime hours. These could result from passage nearby of unusually noisy vehicles such as large trucks or emergency vehicles.

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The on-post sites generally have higher noise levels from roughly 0800 (8 AM) until 1800 (6 PM) than during the remainder of the day. The measurements were made near Libby and Hubbard airfields, and aircraft operations including maintenance that involves ground engine run-up are concentrated during normal working hours. Hubbard Airfield is an unimproved facility at which take-off and landing under simulated tactical airlift conditions is practiced. Operations there are conducted almost exclusively during daylight hours.

Table D-1. Summary of Noise Measurements Made in Conjunction with the Fort Huachuca ICUZ Survey. Measurements Were Conducted During A One-Week Period in July, 1992 and Another During September, 1992.

Site	Mean Daytime Equivalent Sound Level (dBA)	Highest Daytime Equivalent Sound Level (dBA)	Mean Nighttime Equivalent Sound Level (dBA)	Highest Nighttime Equivalent Sound Level (dBA)	Mean Day-Night Average Sound Level (dBA)	Highest Day-Night Average Sound Level (dBA)
Sierra Vista 1	52.2	58.2	50.5	54.6	57.2	60.5
Sierra Vista 2	51.2	55.5	49.6	52.5	56.3	59.1
Sierra Vista 3	52.0	55.1	50.2	53.7	56.9	60.6
Sierra Vista 4	54.4	64.0	55.3	63.9	61.6	72.6
Sierra Vista 5	52.6	55.0	47.6	49.6	55.2	57.3
Sierra Vista 6	53.1	57.9	48.2	53.5	55.8	59.6
Sierra Vista 7	50.2	56.3	43.3	47.6	51.6	55.8
Huachuca City 1	59.8	70.2	56.4	67.8	63.5	73.6
Huachuca City 2	52.3	56.7	46.2	51.4	54.2	58.1
Huachuca City 3	54.4	65.0	44.3	47.4	54.6	62.3
Libby Army Airfield 1	68.3	73.4	54.5	60.5	67.2	72.6
Libby Army Airfield 2	70.2	76.1	54.2	57.3	68.8	73.9
Hubbard Airfield 1	62.8	68.4	44.2	47.7	61.1	66.4
Hubbard Airfield 2	67.0	71.8	51.3	61.4	65.5	69.7

Source: ICUZ (USACHPPM 1997).

D.2.2 Other Noise Measurements

It is reasonable to expect that the noise level at Fort Huachuca at locations away from the airfields would be comparable to the noise levels measured in Sierra Vista and Huachuca City. As part of the Environmental Assessment for Fielding and Operation of the M-1 Tank at Fort Huachuca, Arizona (COE 1994), a single daytime measurement of equivalent sound level was conducted in October, 1991. The measurement was made between 1520 and 1530 (3:20 and 3:30 PM). Although at this time of day, the commuter traffic level would not be at its maximum, official traffic, much of which consists of heavier, noisier vehicles, would be near its highest level. Furthermore, there was a noise contribution from a nearby construction project and from a passing helicopter during the measurement period. The result of the measurement was a 10-minute equivalent sound level of 58.4 dBA. This is higher than the mean daytime value for all but 1 of the 10 off-post monitoring locations, and when compared with the highest daily equivalent sound levels over the entire 2 weeks of measurements, it is somewhat above the median. Therefore, this measurement appears to be consistent with the expectation that the off-post measurements would be similar to the on-post measurements made at points reasonable distant from the airfields.

D.3 ENVIRONMENTAL EFFECTS

Major sources of noise at Fort Huachuca include military vehicles and other vehicles, weapons firing, and aircraft.

D.3.1 Baseline Conditions

Under baseline conditions, current activities at Fort Huachuca would continue, and as a result of separately evaluated Base Realignment and Closure actions, some increases in the activities above 1995 levels would occur. Noise predictions were based on a 5.4% per year increase in acoustic energy for a 30% increase over 5 years. This would lead to a noise level increase of 0.23 dBA per year and 1.1 dBA over 5 years.

D.3.1.1 Military Vehicles

Many types of training are conducted at Fort Huachuca, often involving heavy vehicles and large trucks. Other training activities involving tank maneuvering and firing have been proposed and are being evaluated under separate NEPA documentation. For the purposes of this baseline discussion, noise from tanks, heavy vehicles and weapons firing will be considered even though many of these activities are not currently authorized at the installation.

The M-1 tank produces a noise level of 84 dB at 30 m, or 10 dBA lower. Using the very conservative estimate of 2 dB per mile for atmospheric absorption, the sound level from a single M-1 tank would be 63.5 dB at a distance of 1,000 feet, and, 47.4 dBA at a distance of 1 mile. A platoon of 4 M-1s in close proximity to each other would produce a level of 69.5 dBA at 1,000 ft and 53.4 dBA at 1 mile. A company of 14 M-1s that pass in single file 1,000 ft from a fixed point would produce a maximum level of 74.8 dBA and 58.9 dBA at 1 mile.

Other heavy military vehicles are acoustically similar to or even noisier than M-1 tanks. For example, the noise level of a heavy dump truck is typically 91 dB at 50 ft (May 1978), or 85 dBA at 30 m. Bulldozers typically produce a level of 87 dBA at 50 ft (81 dBA at 30 m). Light and medium military vehicles are generally quieter than tanks.

D.3.1.2 Weapons Firing

Noise effects of weapons firing is more complex to predict. During 1992, a total of nearly 1.5 million rounds of .50 caliber and smaller non-exploding ammunition were expended at Fort Huachuca firing ranges, over 3,800 40 mm rounds, 120 105mm rounds, 230 tube-launched illuminating devices, and 78 1-1/4 blocks of C-4 high explosive. In addition, over 1,000 miscellaneous pyrotechnic devices that produce significant noise were

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used. Under a separate environmental assessment, the replacement of M-60 tanks carrying 105 mm guns with M-1 tanks carrying 120 mm guns was considered (COE 1994). Therefore, this assessment is based on the larger round.

Small Arms

The sound level produced by a rifle or handgun depends on the weapon type, type of ammunition, the angle between the line to the observer and the line of fire, and the distance to the observer. Goff and Novak (1977) present a simplified methodology for estimating the equivalent noise level resulting from a small arms range. The methodology is based in part on a graph of the A-weighted sound exposure level per round fired as a function of distance. The chart implicitly includes the effects of atmospheric attenuation. At a distance of 1,000 ft from the firing position, the largest A-weighted sound exposure level per round is 70 dBA. To ensure a conservative noise estimate, the total number of rounds were assumed to be fired during 500 hours of training for a rate of 3,000 per hour. The Goff and Novak methodology predicts an equivalent sound level of 69 dBA at a distance of 1,000 ft under these conditions. At 1 mile, the predicted equivalent sound level during firing is 53 dBA. Another scenario that was considered was for firing to take place at the rate of 1,000 rounds per hour for 24 hours. The day-night average sound level on such a day would be 71 dBA at 1,000 ft and 55 dBA at 1 mile. Therefore, small arms firing is highly unlikely to generate noise complaints from Sierra Vista or Huachuca City, and the contribution of small arms fire to the noise background is at or below the 55-dBA day-night average goal for residential areas. A 30% increase in the activity level could increase the maximum noise levels by 1.1 dBA. It is possible, however, that an increase would be accommodated by using range facilities at times when they had not been in use previously. In that case, the duration but not the magnitude of the noise exposure would increase.

Large Bore Weapons and Explosive Devices

As with small arms, the sound level depends on the weapon type, type of ammunition, the angle between the line to the observer and the line of fire, and the distance. The closest firing of large bore weapons to populated areas is associated with armored vehicles on Firing Range 12C. Noise effects of firing 120 mm tank cannons on that range were evaluated in Environmental Assessment for Fielding and Operation of the M-1 Tank at Fort Huachuca, Arizona (COE 1994). The methodology presented in that document predicts the sound pressure level (SPL) resulting from impulsive overpressure from firing 120 mm tank cannons at the residential area nearest the 12C Firing Range, approximately 1 mile away. The predicted sound pressure level from firing the cannon is 111 dB. If 2 nearby tanks fired simultaneously, the SPL would be 114 dB. Data presented in COE (1994) indicate that complaints by the public are unusual if the SPL is 115 dB or lower. Although single rounds would not exceed this threshold at the nearest residential area, simultaneous firing of 3 or more cannons would result in SPLs that might cause complaints.

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Explosive effects must also be considered. Explosive ordnance includes 120 mm projectiles, hand grenades, and small blocks of C-4 high explosive used in training. Overpressures were derived from the computer model CONWEP (Hyde 1992) and scaled appropriately. The 120 mm anti-armor round is not in the CONWEP database, so the 155 mm high explosive round was used as a conservative proxy. CONWEP predicts that the SPL resulting from the surface detonation of this round would be 70 dB at a distance of 1 mile. The detonation of a 1-1/4 lb demonstration block of C-4 high explosive would produce an SPL of 61 dB at 1 mile. All detonations would take place at a distance of greater than 1 mile from the nearest residential area. Therefore, detonation noise has very little likelihood of generating complaints from the public.

Live firing of large weapons is among the most expensive of training activities and is done at a low rate. It is unlikely that increased training activity at Fort Huachuca would result in simultaneous firing of multiple weapons. Therefore, an increase in the training activity would be likely to increase the duration but not the magnitude of the noise exposure.

D.3.1.3 Aircraft

For 1992, the most recent year during which airfield operations were not curtailed because of construction, there were 88,818 aircraft operations at Libby Army Airfield. Another 21,060 aircraft operations were conducted from other locations within Libby's control area for a total of 109,878. The Arizona Air National Guard (ANG) Field Training Site Master Plan projects aviation activity through the Year 2010. The projected total operations is 122,400 for Year 1995, 128,900 for Year 2000, and 140,200 for the Year 2010. Aircraft noise was the dominant contributor to the background at the airfield monitoring locations. Given this level of increase in aircraft activity, and assuming that the mix of aircraft and distribution of operations through the day would remain the same, the increase from 109,878 operations to 128,900 operations, a 17% increase, would lead to an increase in measured equivalent sound levels of 0.7 dBA in Year 2000 above the 1992 values.

D.3.1.4 Vehicular Traffic

Vehicle usage would also increase as a result of increases in activities and population at Fort Huachuca. Projections of activities and population can be misleading because growth rates can vary widely from year to year as a result of Base Realignment and Closure actions. Again, a 30% increase from 1992, the year in which the measurements were made, to 2000 was assumed. This would be nearly twice the rate of increase for aircraft operations. Thirty percent would correspond to an increase in the sound level of 1.1 dBA

D.3.1.5 Construction

Construction of buildings and other facilities at Fort Huachuca is unlikely to cause major increases in noise levels except in the immediate vicinity of the construction site. Furthermore, construction activities are temporary in nature. Typical construction equipment noise levels range from 76 dBA at 50 ft for electric generators to 91 dBA at 50 ft for large dump trucks. A construction site with 5 pieces of equipment in simultaneous operation, each producing a noise level of 90 dBA, would produce a noise level of 71 dBA at 1000 ft and 57 dBA at 1 mile. Except in the immediate vicinity of the activity, the effects would be negligible.

D.3.3 Effects of Noise on Wildlife

Although noise effects on the human population of Fort Huachuca and the surrounding community have been shown to be minimal, there is the possibility that noise would result in adverse effects on wildlife in the vicinity of tank maneuvering areas and firing ranges. The potential effects vary widely by species, and many species habituate to a remarkable degree. For example, many bird species commonly become residents of airports where they are regularly subjected to non-impulsive noise levels easily reaching 100 dBA.

Numerous studies have been conducted in which birds and mammals have been subjected to various types and intensities of sounds (Memphis State University 1971). A general conclusion of the studies is that at high enough intensity and duration (or repetition for impulsive sounds), measurable auditory effects occur, sometimes observable as physiological effects in the cochlea. The least significant effect is usually a temporary threshold shift in which an animal's sensitivity to low intensity sound increases during exposure but returns to normal after exposure. The most significant effect is destruction of hair cells in the cochlea. Most of the studies that detected observable physiological damage were conducted at very high sound exposure levels such as 20 minutes of continuous exposure to a 500 Hz pure tone at 128 dB. All studies that demonstrated observable damage were conducted on confined animals.

Sound exposure has also been shown to disrupt behavior patterns of animals. For example, a study conducted with brood hens found that exposure to noise at 120 dB resulted in a high likelihood of nest abandonment. Another study documented a tendency of wild mammals to prefer nesting sites away from sound sources. It has been demonstrated that for sound to be effective in repelling birds, an SPL of 85 dB at the bird's ear was required. Other studies were unable to detect observable effects of noise on animal behavior. One such study involved cows subjected to noise from low-flying high performance aircraft, and another involved wild birds near a busy airport.

Wild animals are not confined. When subjected to high noise levels, most animals leave the area and so are unlikely to be exposed to noise levels with significant potential to damage hearing. However, behavioral disruption is a possibility. It is unlikely that birds, bats, or larger mammals would remain in intensively used tank maneuvering areas or firing ranges during training activities.

The lesser long-nosed bat (Leptonyterous curasoae yerbabuenae) is 1 species of concern that inhabits Fort Huachuca. This bat uses certain plant species as a food resource during part of the year. Fort Huachuca training programs are carried out with great sensitivity to the needs of this species. Training schedules do not permit potentially disruptive activities near roosting sites of these bats during critical times of the year.

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D.4 REFERENCES

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APPENDIX E HEALTH AND SAFETY

Table E-1: Hazardous Materials Regulations and Procedures Applicable to Fort Huachuca.

Hazardous Materials Management	
29 CFR 1910 OSHA	Training, Handling, Storage
40 CFR 302, Table 302.4	Reportable Quantities of Hazardous Material Spills
49 CFR 171-179 & AR 55-355	Labeling and Transportation of Hazardous Material
AR 200-1	Environmental Protection and Enhancement
AR 420-9	Flammable Materials Storage Area
Executive Order 12856	Federal Compliance with Right-To-Know Laws and Pollution Prevention Requirements
U.S. Army 415S.19-R-I	Hazardous Commodities Storage
Pesticides, Herbicides and Rodenticides	
29 CFR 1910	Training and Handling
40 CFR 156,162, 165, 170, 171	Labeling, Registration, Disposal, Storage, Handling, and Certification
AR 200-1, AR 200-1.5.5	Health Monitoring, Pest Management, Plan Handling and Record Keeping
AR 200-1-6.10, AR 420-74 & AR 42-76	
U.S. Army 4150.7	Pest Management Program
U.S. Army 4160.21-M	Disposal and Record Keeping
Polychlorinated Biphenyl (PCB) TSCA	
40 CFR 761	PCB Requirements
AR 200-1	Handling, Use Storage, Disposal, Records, and Reporting
50 FR 29170	PCBs Transformer Fire Rules
Underground Storage Tanks (UST)	
40 CFR part 280	UST Regulations
Arizona Statutes Annotated ARS 49-1001 through ARS 49-1073	Arizona UST Regulations
Radioactive Materials	
Nuclear Regulatory Commission	Regulates federal agencies under the Atomic Energy Act
Petroleum, Oils, and Lubricants	
U.S. Army Manual 4140.25-M and waste oil recovery and recycling Fort Huachuca regulations.	
Hazardous Waste Management	
40 CFR 260-271 (RCRA)	Hazardous Waste Management
40 CFR 370, 372	Community Right To Know
49 CFR 171-179 (DOT)	Transportation
AR 200-1	Environmental Protection and Enhancement
AR 420-47	Solid and Hazardous Waste Management
DEQPM 80-5	U.S. Army Hazardous Waste Disposal Policy
DEQPM 80-8 RCRA	
Arizona Revised Status 49-921-973	Hazardous Waste Management Act

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Table E-2: Hazardous Waste Regulations and Procedures Applicable to Fort Hucahuca.

Regulations	
40 CFR 260-271 (RCRA)	Hazardous Waste Management Regulations
40 CFR 370, 372	Community Right To Know
49 CFR 171-179 DOT	Transportation
AR 200-1	Environmental Protection and Enhancement
AR 420-47	Solid and Hazardous Waste Management
DEQPM 80-5	U.S. Army Hazardous Materials Disposal Policy
DEQPM 80-8	RCRA
ADEQ Statutes Annotated ARS 49-1001 through ARS 49-1073	Hazardous Waste Management

Table E-3: Fort Huachuca, Arizona, Hazardous Waste Typical Users List. (1 of 2)

Unit Activity	Location/Building	Stream
11 Signal Bde Motor Pool	51437	Li.Mg. Bat/Paints
304th MI BN Battery Storage	82502	Li Batteries/Resins
305th MI BN Battery Storage	80505	Li Batteries
309th MI Bn GSR	15540	Silver Bats.
504th Signal BN R&U Shop	67115	Paint
8/40th Armor BN	74902	Paints
AMSA 18	75805	Paints
EPG Warehouse	30025	Lithium Batteries
EPG Motorpool	68049	Oils
JTIC Battery Shop	57428	Li Bat./Mercury
Aerostat Site	16201	Li Bat
AAFES-Main Branch SAP	52030	Misc.
AAFES-Service Station	31210	Oils
Brown & Root	13524	Ammunition, lead acid bat., paints, blast media, misc.
DOL/B&R Fuel Facility	86001	Fuels
DOL/B&R Laundry Cleaning	90201	Distilled perc. sledge, spent filters, flammable
Devices Branch	82012	Resins/paints
DPCA	71810	Oils/paints, petroleum based maint. cds, oils, toner
DEH Billeting	41415	Cleaning supplies
DEH Waste Water Laboratory	90718	Reagents/sample residue
DENTAC	45005	Mercury

Table E-3: Fort Huachuca, Arizona, Hazardous Waste Typical Users List. (2 of 2)

Unit Activity	Location/Building	Stream
DRMO	90506/90507	Misc./varies with time
J&J Maintenance, LAAF	91110	Solvents/paints
MEDDAC-Supply OPS	45022	Misc. reagents/parms.
SCITEK Barber Green	55421	Misc.
Grounds Maintenance		TBD
TMDE, Greey Hall		Lithium batteries
U.S.A.C.E. Construction Sites		Varies
Vitro Services	68048	Varies
GSR Maintenance	15540	Li batteries

Table E-4: Satellite and POL Accumulation Points at Fort Huachuca.

Satellite Accumulation Points		POL Accumulation Points	
Office Symbol	Building No.	Office Symbol	Building No.
1. JTC-TCCA	57428/57305	ATZS-AAFES PX Gas Sta.	31210
2. ATZS-HSXJ-LO Hospital W/H	45022	ATZS-PCC-V DPCA	71810
3. ATZS-HSXJ-LO RW Bliss Lab, Morgue, Operating Room, Pharmacy, Dental Clinic	45001	AFKC-AKA-LG AMSA 18	75805
4. ATZS-HSXJ-LO Vet Clinic	30022	ATZS-VITRO EPG Contractor	68048
5. ATZS-TDV-D DOT-D Devices Branch	82012	STEEP-EPG Motor Pool	68049
6. ATZS-LOA DOL-J&J Maintenance	91114	ATZS-PCV-B DPCA	52010
7. ATZS-DPCA-MWR	52008	Ft. Huachuca School	47109
8. ATZS-LOW-Q DOL Brown and Root	72901/75901	DOD UAV	12607
9. ATZS-TPP-HE IEW/304th	83502	J&J Maintenance	87841
10. USAF Aerostat	16201	AFR-ACA-AR 8th/40th Armor	74902
11. ATZS-STEEP-SE EPG	30123	TRW-UAV 304th D Co.	11640
12. ATZS-TMP-I 304th A Company	80505	SCITEK Motor Pool, Yard 8	30031/30021
13. SCITEK	22524/22525/55422	ATZS-LOW-Q Brown & Root	90201/74905/75903
14. ATZS-GSR 309th	15540	ASQG-LO 11th Signal	51437/74821/74820
15. TMDE	61801	ATZS-PCB-G	15479
16. STEEP EPG Environmental Test Center	82812	ATZS-TEXCOM TEXCOM-IEWTD	30114
		STEEP-EPG	82812/55436
		ATZS-PCS-LM DPCA-Outdoor Rec.	70914

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Table E-5: Off-Site Treatment and Disposal Facilities Used by Fort Huachuca.[1]

Treatment, Storage, Disposal Facility	Types of RCRA Wastes Accepted From Fort Huachuca FY93
Appropriate Tech, Chula Vista, CA	D001 D002 D006 D007 D008 D009 F003 F005 D035 U188 U058 P042
B.D.T. Inc., Clarence, NY	D003 D007 D009 ORM-C ORM-E
Chem Waste MGM, Kettleman, CA	D001 D008
ENSCO, El Dorado, AR	D001 D002 D003 D007 D008 D009 D013 F001 F002 F003 F005 P001 P042 P030 U088 U058 U129 U188
Mercury Ref Co., Albany, NY	D007 D009
Oil Process Co., Los Angeles, CA	D001 D009
Pen-Rob Corp., Joseph City, AZ	Non-RCRA wastes
Quicksilver PRD, Brisbane, CA	D009
Rinco Chem Corp., AR	D001 D002 D006 D007 D008 D009 D018 D035 D037 D039 D041 F001 F002 F003 F005 P042 U122
U.S. Ecology Inc., Beatty, NV	D008 PCBs (PCBs are non-RCRA waste)

1. EPA Code Definition:

EPA ID #	Description
D001	Ignitable
D002	Corrosive
D002	Chloroform
D003	Reactive
D006	Cadmium
D007	Chromium
D008	Lead
D009	Mercury
D013	Lindane
D018	Benzene
D021	Chlorobenzene
D035	Methyl Ethyl Ketone
D037	Pentrachlorophenol
D039	Tetrachloroethylene
D041	2,4,5-Trichlorophenol
F001	Spent Halogen Degreasing Solvents
F002	Spent Halogenated Solvents
F003	Spent Nonhalogenated Solvents
F005	Spent Nonhalogenated Solvents
P001	Warafin
P030	Cyanides
P042	Epinephrine
U058	Cyclophosphamide
U088	Diethyl phthalate
U122	Formaldehyde
U129	Lindane
U188	Phenol

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Table E-6. Underground Storage Tanks (USTS) in Service at Fort Huachuca.

Location	Capacity (gal)	Contents	Tank ID No.	No. of Tanks
AAFES Gas Station	10000	Gasoline	0-005382	3
R.W. Bliss Hospital	25000	Diesel	0-005375	1
R.W. Bliss Hospital	660	Diesel	0-005375	1
11th Signal B MP	3000	Used Oil	0-00832	1
11th Signal B MP	1000	Used Antifreeze	0-00832	1
Greely Hall	1500	Diesel	0-005352	1
Greely Hall	1500	Diesel	0-005352	1
Greely Hall	8000	Diesel	0-005352	1
11th Signal Vehicle Maint.	1000	Used Antifreeze	0-008354	1
11th Signal Vehicle Maint.	2000	Used Oil	0-008354	1
Post Fuel Point	25000	2 Gasoline	0-005377	2
Post Fuel Point	25000	3 Diesel	0-005377	3
Libby AAF	15000	JP-4	0-005378	3
Libby AAF	24000	JP-4	0-005378	1
Mars Site	800	Diesel	*1	1
Libby AAF	2500	Diesel	0-007606	1
Libby AAF	126	Diesel	0-007228	1
AAFZS Mini-mall	10000	Gasoline	*1	3
111th Vehicle Mt	1000	Used Oil	*1	1
111th Vehicle Mt	1000	Used Antifreeze	*1	1

*1. Registration forms submitted, but number not yet issued

Table E-7: List of PCB-Containing Transformers Still in Use (More Than 50 Ppm and Less Than 500 Ppm Pcbs).

Location	PCB Concentration	Status
103 A Patch	115 ppm	No leaks
1254 Hatfield	93.9 ppm	No leaks
B2316	168 ppm	No leaks
15348 S Range/Shop	150 ppm	No leaks
141 Hatfield/B2733	57.7 ppm	No leaks
B2457	260 ppm	No leaks
118 Meyer B2717	>262 ppm	No leaks
119 Dorsey B2721	100 ppm	No leaks
B2567	167 ppm	No leaks

Table E-8: Total Pesticides, Herbicides and Fungicides Used for 11-Month Period at Fort Huachuca.

Name	Amount
Cynoff	144.20 gal
PT240	53 flo
Pyrethrum	638 flo
Safrotin	44 gal
AC 90	47 pdw
AMDRO	159 pdw
Dursban	38 gal
Glyphosphate	6060 gal
Baygon	20 pdw
Dursban 2E	37 gal
Diquat	13 gal
Wasp Freeze	42 flo
Dursbanze	1 gal
Bromacil	1270 gal
Ooroftanel	160 pdw
Carbaryl	1 pdw

APPENDIX F IMPACTS AND DESCRIPTIONS OF POTENTIAL PROJECTS AS IDENTIFIED IN THE SRC

This appendix provides a description of the potential impacts which may result if projects identified in the SRC (Section 1.2.3) are implemented in the future. When sufficient information is available, individual project descriptions are accompanied by a summary evaluation of the key environmental issues and probable environmental impacts in Section F.2. References cited in this section are provided in Section 8.0 of the DEIS.

F.1 POTENTIAL IMPACTS

Implementation of these projects is not part of the proposed action; however, this appendix provides a preliminary identification of issues and impact evaluation should the projects be implemented in the future. This information is intended to help focus future specific NEPA analysis at the time a decision is made to implement a given project.

F.1.1 Land Use

Implementation of the proposed action involves continuation of existing land use plus new land use described in the land use plan. The goal of this plan is to create a land use pattern that enhances the installation's mission including: using real estate efficiently; promoting compatibility among land use divisions; eliminating detracting activities; co-locating and consolidating functional land use zones; optimizing land use concepts that respect both manmade and natural constraints; protecting the operational capabilities of the installation by promoting compatible land use in areas adjacent to the installation; preserving open space, recreational areas, and natural features; being responsive to planning needs in the surrounding area; and coordinating future development on the installation.

Implementation of the land use plan described above will have a positive impact on the environment by promoting better land and facilities management at Fort Huachuca. Incompatible and environmentally harmful land use will be avoided. Land use management on post will be made more efficient and responsive by the application of GIS and customized environmental decision support systems.

There are no major conflicts between the proposed installation land use pattern described in the Master Plan and that of the City of Sierra Vista. No conflicts in plans and policies of the installation and the USFS Management Plan for the Coronado National Forest exist. Military activities within mountain areas adjacent to the USFS lands occur infrequently and do not involve large scale troop or vehicle movements.

The majority of proposed construction projects occur within the cantonment area and conform to the Master Plan land use planning requirements. Many of these projects represent modifications to and improvements of existing facilities. Others represent new or complete replacement of facilities. A summary of proposed projects is provided in Section F.2.

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Three proposed projects are located outside of the Fort Huachuca cantonment area. These projects are the proposed Effluent Reuse/Recharge Project, ASP, and the UAV facility and runway extension.

The construction of a new ASP on the South Range is required to eliminate the safety concern caused by the location of Bonnie Blink residential subdivision within the explosion zone of the current ASP. The location of the new ASP in the South Range will be in an area not currently used for training activities and will not conflict with the surrounding land use. This proposed facility development will have an overall positive impact on installation land use planning because of the elimination of the current safety problem created by the location of the existing ASP near the Bonnie Blink subdivision.

F.1.1.1 Recreation Resources

If implementation of projects results from the proposed action, no significant impact on recreational resources at Fort Huachuca is anticipated. Usage of the proposed RV facilities will be year-round but with seasonal fluctuations and will serve the existing demand for such services. Maximum usage of the facilities is estimated at 200 persons but average occupancy, based on current demands, is projected to range between 40 and 80. Seasonal fluctuations will result from attractive climate conditions during the winter holiday periods. This projected increase in temporary residents to the area will create a slightly higher demand for regional as well as installation recreational resources, but modest in comparison to other attractions and events in Sierra Vista and surrounding communities.

F.1.2 Socioeconomics

The two factors associated with the proposed action that could potentially generate socioeconomic impacts within the region of influence are (1) changes in personnel levels associated with implementation of the Master Plan and (2) construction, modification, and repair of training facilities and buildings.

The first factor involves employment levels. In the case implementing the proposed action, direct employment at Fort Huachuca and related secondary employment in the region of influence are expected to decrease, therefore population out-migration is anticipated to occur as a result. No increase in authorized employment levels at the installation are associated with possible implementation of projects within the proposed action. The second factor involves expenditures related to the potential implementation of projects from the proposed action. If implemented, each project would generate temporary increases in construction employment and use of local trades.

Temporary increases in construction employment and use of local trades associated with the extensive modification and construction of several buildings and facilities at Fort Huachuca may be expected under implementation of projects from the proposed action. However, long-term impacts of the construction activity are expected to be negligible.

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F.1.2.1 Environmental Justice

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations*, directs federal agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental impacts of their program, policies, and activities on minority and low-income populations in the surrounding community. The 1990 census data were used in this section as the basis of the analysis.

If implemented, most of the proposed projects are centrally located in the cantonment area and would be surrounded by existing facilities (and not low-income or minority populations). The few other projects are located within the installation and are surrounded by open space, training ranges, and operational areas. There are no areas where a majority of residents are low-income or minority populations immediately adjacent to these locations. The proposed action involves no construction or activities that would cause significant adverse health impacts to the general population. Consequently, there would be no disproportionately high or adverse human health or environmental impacts on any population segment, including minority and low-income populations.

F.1.3 Cultural Resources

If implemented, projects within the proposed action consists of a variety of both facilities projects and the potential exists for some broadly varied impacts to cultural resources. This section groups the facilities development projects according to degree of potential impact. Those component projects of the proposed action that, if implemented, may be expected to have no impact or negligible impact are listed first, with no substantive discussion. Projects that may have more substantial impacts are then discussed in greater detail.

Unless otherwise noted, the information below came from a meeting with the Post Archaeologist in December 1996 (Murray, 1996). Prior to implementation, all projects are subject to the review of the Post Archaeologist and will be required to adhere to applicable law and regulation, including AHPA, ARPA, NAGPRA, NHPA, and programmatic agreements. Where surveys are required, or where known impacts to cultural resources will occur, SHPO consultation and concurrence will be required. Any expected or actual disturbance of Native American grave sites will trigger required consultations under NAGPRA.

As a proportion of overall impacts, the gradual deterioration of both historic and prehistoric cultural resources due to natural causes is most significant. The potential impacts of implementation of projects under the proposed action are minor by comparison.

F.1.4 Air Quality

If implemented, projects under the proposed action would result in construction of several new structures and modifications to existing facilities. Some minor, temporary increases in emissions, especially fugitive dust and volatile organics from asphalt paving and painting of buildings would occur. Additional air quality modeling calculations were conducted taking into consideration construction and the expected magnitude of the increases in activity associated with the changes. Those calculations indicate that the concentrations of air pollutants will remain well within current regulatory limits. If projects are implemented as a result of the proposed action, the Fort Huachuca area will remain in attainment of Ambient Air Quality Standards and in compliance with all applicable air quality regulations.

This includes general conformity regulations that are intended to ensure that federal installations abide by the same standards as private sector organizations. Further discussion of air quality investigations is presented in Appendix C.

F.1.5 Noise

Potential noise from potential implementation of projects which may result from the proposed action were investigated. A wide range of impacts was evaluated. This included potential impacts on residential areas of Sierra Vista and Huachuca City; impacts on wildlife; and noise impacts of construction activities.

Additional noise impacts from implementation of any of the projects which may result from the proposed action over and above those of no action will be minimal and likely will not result in significant additional public annoyance or adverse impacts on wildlife.

F.1.6 Geology and Soils

No additional impacts to geologic resources on or near Fort Huachuca, beyond those described in no action, are anticipated for any project implementation which may result from the proposed action.

F.1.6.1 Seismic Risk and Geomorphic Hazards

No additional impacts are anticipated from any projects which may be implemented as a result of the proposed action. New buildings will be built to the appropriate standards of earthquake resistance.

F.1.7 Soils

Implementation of the proposed action would result in approximately 90 acres would be disturbed by new construction, replacement construction, landscaping, and other activities. Of this amount, about 55 acres would represent permanent replacement of native soil with buildings, parking lots, play grounds, and other projects. Nearly 20 disturbed acres would be inside the cantonment area. Most of the remainder would occur on the East Range associated with the construction of the new Effluent Reuse/Recharge Facility. This would result in the permanent displacement of approximately 45 acres of grassland with water recharge basins.

F.1.8 Hydrology and Water Resources

F.1.8.1 Hydrology

Implementation of the proposed action is not anticipated to impact regional hydrologic conditions. If implemented, projects which may result from the proposed action will contribute to continuing a decrease in

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annual groundwater withdrawals from the Fort Huachuca wells, while recharge to the local groundwater system will be enhanced. Funds permitting, the installation's goal is to balance annual pumping with local recharge. However, the withdrawal and use of groundwater in the Sierra Vista municipal service area is expected to continue at or near the present rate, regardless of activities on Fort Huachuca (ADWR 1996). Groundwater overdraft must then be viewed as a sub-regional phenomenon, with the Installation's contribution to this impact showing a declining trend over the past few years.

F.1.8.2 Water Resources

If implemented, projects which may result from the proposed action would have a positive net impact on water resources in the area. In the short term, there would be minimal water use associated with the construction of the facilities development projects; however, the long term benefits derived from these projects would offset short-term impacts. The facilities projects would contribute to the installation's decreasing water consumption due to the installation of water efficient amenities.

Additionally, the Effluent Reuse/Recharge project would upgrade and expand the existing effluent reuse system to help decrease groundwater pumping. The project would facilitate recharge of unused effluent into the aquifer, thus contributing to the groundwater supply.

Implementation of the proposed action would have no significant impact upon water resources in the USPB. This conclusion is based on several factors:

- No net increase in military or civilian population is associated with the proposed action; therefore, there would be no increase in water use on-post due to additional personnel.
- The quality of the groundwater obtained by Fort Huachuca and other users in the USPB is within ADEQ standards, and the proposed action would have no impact on water quality.
- Water consumption at the installation has steadily declined due to an aggressive water conservation program and the use of treated effluent for irrigation. No increase in installation water use would result from the proposed action.

F.1.9 Biological Resources

If implemented, impacts to vegetation would be similar as those discussed under the no action alternative. Important differences would include construction and use of new facilities both in and outside of the cantonment.

If all projects described in the proposed action were to be implemented, up to 90 acres would be disturbed by new construction, replacement construction, landscaping, and other activities. Approximately 55 acres would involve permanent replacement of existing vegetation with buildings, parking lots, playgrounds, roads, and other projects. Approximately 20 acres would be in the cantonment area, but would not involve loss of native species. Approximately 49 acres of disturbance would be associated with new projects including the Effluent Reuse/Recharge System in the East Range (45 acres) and expansion of the UAV facility in the West Range. Both projects would result in limited disturbance of native vegetation. The construction of the ASP in the South Range would result in the loss of about 1.5 acres of native vegetation. The remainder of the disturbed area would be within previously disturbed parts of the cantonment area.

Impacts to riparian areas and wetlands would be similar to those described under no action. Direct and indirect impacts to riparian areas off post should also be beneficial for the same reasons discussed for perennial streams. No projects are planned that would permanently replace or damage any wetland habitats.

Direct and indirect impacts to aquatic biota off post should also be beneficial for the same reasons as discussed above for perennial streams and riparian areas.

F.1.9.1 Wildlife

If implemented, impacts to wildlife resulting from either the no action or the proposed action are similar and would result in negligible habitat loss, modification, and fragmentation..

F.1.10 Protected Species

F.1.10.1 Vegetation

No federally protected plants or critical habitat are known to exist in the cantonment area or East Range. Protected and sensitive species are known in isolated locations on the South and West Ranges. These areas are generally isolated from recreational use and are not near training facilities, vehicle training areas, or ordnance impact areas. No significant environmental impacts are anticipated in those areas from implementation of the proposed action. Protective measures are taken for the Huachuca water umbel, which is found near recreational areas. All new personnel receive "Newcomer's Environmental Orientation" where educational information on protection of species and their habitat is provided.

F.1.10.2 Wildlife

No threatened, endangered, proposed, or candidate species are known to occur on the East Range. Soldier Creek and other ephemeral streams within the East Range, however, may serve as travel corridors for wildlife including protected species. No information is available to determine if these potential corridors are used and if used to what extent. Because no habitat is present and travel corridors probably would be used only on an infrequent basis, the potential for impact from implementing the proposed action is low.

Some protected species are present on the West and South Ranges. Noisy small arms training and vehicle traffic and maneuvers would occur year round.

Mexican spotted owls in general have extremely sensitive hearing with audible frequency ranges ranking among the best high-frequency (0.4-9 kHz) hearing presently known in birds (Manci et al. 1988 American peregrine falcons and Mexican spotted owls have demonstrated adaptability to some noise levels/events. Observations were made of nesting spotted owls being overflown in Colorado. Owls did not respond or only turned their heads toward the sound even though the sound from the jet engines was greater than 90 dBA (Reynolds and Johnson 1997). A study on the impacts of noise from simulated sonic booms to seven species of nesting raptors, including peregrine falcons in Arizona (Ellis et al. 1991) found that raptor responses were limited to temporary flushing of adults from nests. The noise levels of the sonic booms in the study ranged from 112 to 151 dBP and did not reduce subsequent nesting success or territory occupancy.

The lesser long-nosed bat are not anticipated to experience significant environmental impact from small arms training on the South Range. No significant impacts to bats due to noise would be produced as a result of implementing the proposed action. Similarly, roost sites for the bat on the West Range are in remote locations. Therefore, these sites are not anticipated to experience significant environmental impact as a result of implementation of activities under the proposed alternative.

Noise from the launch of unmanned aerial vehicles would produce very loud ultrasound, overlapping the bat's hearing in a wide band of frequencies. The noise generated by the takeoff rockets ranged from 76 to 93 dB and was well above the minimal noise that triggers a response in the bat's auditory system (Howell 1992). Noise and presence of vehicles during training in the South and West ranges would be primarily during the day. Bat foraging would not be impacted since the lesser long-nosed bat forages through the night.

Noise impacts to the endangered Sonora tiger salamander and candidate Ramsey Canyon leopard frog, which are known to be present in the West or South ranges, would be negligible because the distance from the noise source to known locations of these species would diminish sound levels to negligible levels.

Training-caused or other man-caused wildfires have the greatest potential to cause significant impacts on protected species. Potential impacts of fire to threatened and endangered species include direct mortality; direct destruction of nesting, wintering, or foraging habitat; and indirect destruction or degradation of habitat through post-fire flooding, erosion, and sedimentation. Burning of extensive agave stands may also result and impact the lesser-long-nosed bat. A plan is currently under development to reintroduce managed burns to reduce these damages.

Ordnance may also directly injure protected species. The probability of this occurring would be very low because of the limited amount of firings, the low quality of habitat in the impact areas and ranges, the presence of humans, and the distance from ranges and impact areas to known locations of protected species. Mitigations are in place to reduce impact on species.

Recreational use of Fort Huachuca is expected to continue at current or slightly increased levels. Over 30,000 bird watchers visited the South Range in 1995 (personal communication, Stone 1996). However, visitation of habitats used by Mexican spotted owls and peregrine falcons for nesting is prohibited during nesting season. Educational information is provided to users to ensure that visitors do not inadvertently disturb protected species.

No impacts to protected wildlife off-post would be anticipated from implementation of the proposed action alternative. No off-post habitat would be disturbed and testing and training activities would be limited to existing roads and built areas.

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Impacts to protected species would be similar as those described for no action. Under current range management, the likelihood of extensive fire caused by Fort Huachuca operations is low. With implementation of the fire prevention and suppression mitigation measures described in the Fire Protection Plan, the likelihood of a fire burning into spotted owl territories or peregrine falcon nest sites would be reduced even further. Similarly, the probability of a fire burning extensive agave stands would lessen because of the plan and fire breaks that are maintained throughout the area. This is demonstrated by the relative moderate frequency of fires in the past with each fire being contained in a small area.

F.1.11 Safety

Many structures that are proposed for rehabilitation or replacement are in poor condition and lack appropriate facilities for handicap access and evacuation in case of emergency. If projects under the proposed action were implemented, these facilities would be upgraded, improving safety conditions for those facilities. Construction of a new ASP would result in moving ammunition storage away from existing housing in the cantonment and would be a significant improvement in installation safety. Some construction-related accidents could be expected during facility construction/renovation projects.

F.1.12 Energy

If projects from proposed action are ultimately implemented, there will be no significant impact to energy resources or utilization at Fort Huachuca. Stationary energy use per square foot of building space has been steadily decreasing for the past several years, although total electrical consumption has increased each year until the current year. Fort Huachuca's peak demand in the last five years was 21,348 kW in January 1994. The capacity of the primary transmission line is 124,000 kW, and the capacity of the main substation is 42,000 kW. Using the actual average rate of increase in demand from 1989 through 1994, the capacity of the substation would not be reached for more than 20 years. While proposed implementation of facilities may slightly increase annual electrical usage as a result of new buildings and facilities, this increase is not anticipated to exceed the capacity of the installation's primary transmission line. The construction of new energy-handling facilities is not anticipated and the peak electricity usage for the installation is predicted to remain below its peak capacity. New facilities will incorporate energy conservation devices such as high efficiency lighting fixtures, energy efficient motors, high rated insulation, and additional technical efforts to maximize energy efficiency throughout the building. Therefore no significant increase in annual energy consumption will occur. As more conservation projects come into service, electrical demand and consumption may actually decline further, and it is likely that the capacity of the delivery system will not be reached.

Consumption patterns of all types of fuels used at Fort Huachuca are guided by Fort Huachuca's Energy Resource Management Plan (ERMP) which sets goals and establishes policies for energy consumption. More efficient energy use and a growing solar energy program have helped the Army meet consumption goals. Energy consumption for heating/cooling fuel consumption has shown a decline in recent years as a

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direct result of the aggressive conservation program. Under the proposed action, these trends are likely to continue into the foreseeable future.

No additional impacts concerning alternative energy resources are expected as a result of the proposed action. Currently, the Army is pursuing a policy of greater use of alternative energy sources. Solar energy is used for some heating as well as the lighting of signs, parking lots, and streets. The Army will continue to make use of alternative energy when possible.

F.1.13 Waste Management

If projects from proposed action are ultimately implemented, the proposed construction and renovation activities would result in a temporary increase in construction and demolition debris, including asbestos and materials containing lead-based paint. These materials would continue to be disposed in licensed landfills. Impacts would be minor resulting in a slightly faster filling of licensed landfill space. Continued reduction in installation population combined with recycling efforts would result in less waste generation, especially MSW.

F.1.14 Transportation

If projects from proposed action are ultimately implemented, very few impacts to the transportation system of Fort Huachuca would occur. Many of the projects have no impact on the transportation system at all, and others have minor impacts but do not require any transportation improvements.

Traffic patterns on Fort Huachuca will change due to the completion of the eighteen projects. No new personnel are being assigned to the installation due to the construction projects, therefore, overall traffic is not expected to increase on post. However, several functions are being relocated within Fort Huachuca which will change the travel patterns at Fort Huachuca. Planning information through FY 2000 indicates a net loss of 500 positions at Fort Huachuca which is three percent of the installation's population. This reduction in personnel will decrease commute hour traffic at Fort Huachuca. The combined impact of a decrease in personnel and the relocation of personnel within the installation, make it difficult to precisely predict the changes in travel patterns for the installation. However, the existing roadway network will be able to adequately handle the traffic generated within the installation and no impacts requiring improvements are anticipated except for the ones previously mentioned.

F.2 PROJECT DESCRIPTIONS

This section contains descriptions of potential projects and a summary of representative impacts that may be associated with the construction of each project in the future. Additional projects not identified in Section 1.2.3 of this EIS may also be included in this appendix because the SRC plan update is representative of MCA projects (see Table 1.2-4) and selected short-range OMA projects (see Table 1.2-5) as formally programmed during the production of the update. These other projects may or may not be considered as

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future MCA or OMA projects or could be removed from consideration at a later date. The location of these various projects is shown in Figure F-1.

F.2.1 FY00-FY04 Military Construction Army (MCA) Projects

The projects in this section of this appendix match those in Table 1.2-4, Section 1.2.3 of the EIS.

F.2.1.1 Project 10106 - Electronic Maintenance Shop (11th Signal Brigade)

This project would require construction of a 21,000 square foot electronic maintenance shop to include built-in benches, recessed bays, a 1,300 square foot loading dock, and a 24,795 square foot vehicle parking area. This action includes the demolition of seven existing buildings on site (totaling 20,925 square feet). This project is included in the SRC and conforms to the LRC.

Environmental Issues

- Safe disposal of demolition debris, possibly including asbestos
- Noise associated with construction and demolition activities
- Fugitive emissions (dust and possibly hydrocarbons from paving) from construction and demolition activities
- Habitat modification of any areas where buildings and the vehicle parking area disturb ground not presently covered by existing buildings/structures. Need to know how much area is replacement construction and how much undisturbed ground will be disturbed. What type wildlife habitat is disturbed?

Probable Environmental Impacts

There would be no significant environmental impacts associated with implementing this project. Demolition debris is disposed offsite in landfills permitted for the types of wastes produced, construction and demolition debris, asbestos, etc. Construction noise would be minor, temporary, and typical of construction activities routinely occurring on the Installation. Fugitive dust emissions would be minor.

F.2.1.2 Project 10496 -Criminal Investigation Division Command Field Operations Building

This project would involve the construction of a 6,360 square foot modified standard design CIDC field operations building with administrative and property storage space. This activity is included in the SRC and conforms to the LRC.

Environmental Issues

New construction in an undisturbed area

Probable Environmental Impacts

If no sensitive biological or cultural resources are affected then the impacts would be minor. The area disturbed would be minimal.

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F.2.1.3 Project 43410 - Bowling Center

This project would involve the renovation of the existing 24 lane bowling alley. Actions include the modification and upgrade of the existing machinery and remodeling of interior space, including computerized scoring lanes, food and beverage ordering system, sound system, interior lighting upgrade and new furnishings. The project would require upgrading the electrical power, heating, and cooling systems. This activity is included in the SRC and conforms to the LRC.

Environmental Issues

Small amount of debris associated with building renovation

Probable Environmental Impacts

Because the project involves renovation of an existing structure with no known historical or architectural significance, environmental impacts would be very limited and minor. Some debris would be produced which would require disposal.

F.2.1.4 Project 41494 - Whole Neighborhood Revitalization (Calvary Park 5)

The project involves replacement of 90 dwellings in CP5 subdivision with 90 new dwelling units. Construction would include the demolition of 90 existing structures and extension, modification and replacement of street utility infrastructure, and associated recreation facilities and landscaping to meet current construction standards. New units would include passive solar features, heating by natural gas, central evaporative cooling, and energy efficient appliances and lighting. This activity is included in the SRC and conforms to the LRC.

Environmental Issues

- Safe disposal of demolition debris, possibly including asbestos
- Noise associated with construction and demolition activities
- Minor fugitive dust emissions from construction and demolition activities
- Landscape disturbance

Probable Environmental Impacts

There would be no significant environmental impacts associated with project implementation. Some construction and demolition debris would be disposed off site at a landfill permitted to receive such waste. Because the action would replace existing structures with new ones in the same location, no new area would be disturbed except for approximately 2 acres, which would be landscaped. This area is already residential in nature and wildlife common to residential communities would be temporarily displaced from this acreage until the area was revegetated.

F.2.1.5 Projects 46756 - Effluent Reuse System

This proposed activity has two associated facilities and is a component of the Fort Huachuca Water Resources Management Program. Conceptual design and construction details for both facilities are provided in Volume 1: Reclaimed Water Reuse/Recharge of the Fort Huachuca Water Resource Management Program. The proposed reuse system is the upgrade and expansion of the existing effluent reuse system. This includes the construction of a new effluent line distribution system to additional areas within the cantonment area for irrigation purposes. The distribution system will connect the existing treated effluent system to the expanded system. The proposed construction includes two new water storage tanks ((one million gallon (MG) and one 250,000 gallon)), the permanent covering of three (3) existing storage ponds (one 1.8 MG and two 0.7 MG ponds) to reduce algae growth and maintain the quality of the effluent, and the addition of booster stations and necessary piping and valves to make the system operational and extend its range across the cantonment area.

The proposed recharge system will be designed to recharge into the aquifer all the effluent not used in the reuse system. The proposed system will consist of ten 4.5 acre shallow infiltration basins, an automated weather relay station receiver, operations building, monitor wells, pump station and associated piping and valves, access roads and parking (four vehicles), and a secondary treatment facility. The proposed facility location is on the southwestern edge of the East Range with connections to the existing effluent reuse system on the eastern edge of the cantonment area (Methods for determining proposed location are included in the Fort Huachuca Water Resource Management Plan, Volume 1: Reclaimed Water Reuse/Recharge, 1995).

Environmental Issues

- Positive impact on the aquifer feeding the San Pedro River
- Positive impact of water reuse for irrigation
- Construction of 45 acres of ponds from dry land
- Other construction impacts associated with tanks, lines, parking, roads, etc.

Probable Environmental Impacts

Fort Huachuca has been using treated effluent to water the golf course and a large parade field for over a decade. Currently, approximately 40 percent of the Installation's annual 650 million gallons of treated wastewater is being used for landscape maintenance at areas including the gold course, Chaffee Parade Field, and the Outdoor Sports Complex. Fort Huachuca is now planning to reuse or recharge almost all of the effluent generated on the installation. Project funding for expanded effluent reuse and recharge projects is the year 2000 is $10M. Future plans indicate that 86 percent of the installation's landscape requirements could be met by expanding the existing treated effluent distribution system. A sixteen percent, or 460.3 ac-ft (150 million gallon), reduction in the installation's annual groundwater demand would result from this effort. These two projects would be a integral part of that systems upgrade and would contribute to the expected water savings.

F.2.1.6 Project 37016 - Golf Course and Clubhouse

This proposed project would replace 19 greens and one practice putting green at the U. S. Army Intelligence Center and Fort Huachuca Golf Course. Total surface area to be disturbed is 9,777 square yards plus a collar around each green. Tree root invasion will have to be barricaded. Treated effluent is proposed to be used to water the greens. Some recontouring will be required to avoid low areas and water stagnation.

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Environmental Issues

Use of treated effluent (reduces water use-a positive impact) and may have some metals contamination

F.2.1.7 Project 47283 - Vehicle Maintenance Shop

This project would result in the demolition of 14 buildings (26,667 square feet) currently occupied by the 11th Signal Brigade. A vehicle maintenance shop would be constructed, which would include 800 square feet of storage space and 52, 186 square yards of hardstand area.

Environmental Issues

New construction in a previously disturbed area

Probable Environmental Impacts

If no cultural resources are affected then the impacts would be minor. The area disturbed would be minimal.

F.2.1.8 Project 49899 - Whole Neighborhood Revitalization (Bonnie Blink 1)

This project would revitalize 110 family housing units in 55 buildings.

Environmental Issues

- Safe disposal of demolition debris, possibly including asbestos
- Noise associated with construction and demolition activities
- Minor fugitive dust emissions from construction and demolition activities
- Landscape disturbance

Probable Environmental Impacts

There would be no significant environmental impacts associated with project implementation. Some construction and demolition debris would be disposed off site at a landfill permitted to receive such waste. Because the action would replace existing structures with new ones in the same location, no new area would be disturbed. This area is already residential in nature and wildlife common to residential communities would be temporarily displaced from this acreage until the area was revegetated.

F.2.1.9 Project 31429 - Whole Neighborhood Revitalization (Pershing Plaza)

This project would revitalize 35 one-bedroom units, 59 two-bedroom units, and 74 three-bedroom units in Pershing Plaza West 3 and East 2.

Environmental Issues

- Safe disposal of demolition debris, possibly including subsists
- Noise associated with construction and demolition activities
- Minor fugitive dust emissions from construction and demolition activities
- Landscape disturbance

Probable Environmental Impacts

There would be no significant environmental impacts associated with project implementation. Some construction and demolition debris would be disposed off site at a landfill permitted to receive such waste.

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Because the action would replace existing structures with new ones in the same location, no new area would be disturbed. This area is already residential in nature and wildlife common to residential communities would be temporarily displaced from this acreage until the area was revegetated.

F.2.1.10 Project 45967 - Recreational Vehicle Park Expansion

This project involves the construction of a 100 pad addition to the RV Park. The proposed activity includes full hookups, propane fill station, sewage, playground and ramadas and a 2,446 square foot support building to include a restroom, showers, laundry, and administrative office. The proposed location is in an undisturbed area on the edge of the cantonment area adjacent to the West Range but conform to the LRC.

Environmental Issues

- Project would be built on a 20-acre site adjacent to an undisturbed portion of the West Range. While the actual acreage of ground disturbed would be minor, habitat fragmentation of the 20-acre site is a potential issue
- The quality of the disturbed habitat for supporting wildlife, an in particular, if any of this habitat is important for the threatened and endangered species onsite must be examined
- Increased recreation activities adjacent to the RV Park need to be examined in light of possible conflicts with wildlife
- Does this action result in increased water use at FH?
- Will waterless urinals be installed at the site to help offset some increased water use?

Probable Environmental Impacts

Access to the site is provided off of Whitside Road. The expansion of the recreational vehicle park by 100 spaces will increase traffic by 300 one-way vehicle trips a day to 450 one-way vehicle trips per day when the park is at capacity Several questions above need to be answered before impacts can be more fully stated.

F.2.1.11 Project 47309 - Electronic Maintenance Shop

This project would require demolition of ten buildings comprising 29,106 square feet with asbestos removal. An Electronic Maintenance Shop would be constructed. Supporting facilities include utilities, electric service, storm drainage, fire protection and alarm systems, security lighting and fencing, parking and paving, information systems and site improvements.

Environmental Issues

New construction in a previously disturbed area

Probable Environmental Impacts

If no cultural resources are affected then the impacts would be minor. The area disturbed would be minimal.

F.2.1.12 Project 31430 - Whole Neighborhood Revitalization (Pershing Plaza East)

This project would revitalize 16 one-bedroom, 102 two-bedroom, and 48 three-bedroom nits in Pershing Plaza East 1 and 3.

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Environmental Issues

- Safe disposal of demolition debris, possibly including asbestos
- Noise associated with construction and demolition activities
- Minor fugitive dust emissions from construction and demolition activities
- Landscape disturbance

Probable Environmental Impacts

There would be no significant environmental impacts associated with project implementation. Some construction and demolition debris would be disposed off site at a landfill permitted to receive such waste. Because the action would replace existing structures with new ones in the same location, no new area would be disturbed. This area is already residential in nature and wildlife common to residential communities would be temporarily displaced from this acreage until the area was revegetated.

F.2.1.13 Project 42779 - Vehicle Maintenance Shop

This project is for the 19th Signal Company, 11th Signal Brigade.

Environmental Issues

New construction in an undisturbed area

Probable Environmental Impacts

If no sensitive biological or cultural resources are affected then the impacts would be minor. The area disturbed would be minimal.

F.2.1.14 Project 31434 - Whole Neighborhood Revitalization (Pershing Plaza West 1 and 20)

This project would revitalize 87 two-bedroom, and 76 three-bedroom units in Pershing Plaza West 1 and 2.

Environmental Issues

- Safe disposal of demolition debris, possibly including asbestos
- Noise associated with construction and demolition activities
- Minor fugitive dust emissions from construction and demolition activities
- Landscape disturbance

Probable Environmental Impacts

There would be no significant environmental impacts associated with project implementation. Some construction and demolition debris would be disposed off site at a landfill permitted to receive such waste. Because the action would replace existing structures with new ones in the same location, no new area would be disturbed. This area is already residential in nature and wildlife common to residential communities would be temporarily displaced from this acreage until the area was revegetated.

F.2.1.15 Project 33321 - Youth Center Addition

This proposed project would require the construction of a 5,332 square feet addition to the existing Youth Center facility (Building 49103) and a new outdoor recreation area. Approximately 5,634 square feet is scheduled to be demolished in association with this project. This activity is included in the SRC and conforms to the LRC.

Environmental Issues

- Minor construction debris
- Noise during construction

Probable Environmental Impacts

There may be some minor noise-related annoyance and inconvenience of personnel using the existing Youth Center facility during the construction of the addition.

F.2.1.16 Project 42752 - Whole Neighborhood Revitalization (Calvary Park 1 and 6/Signal Village 1/De Anza Village 2)

This project would revitalize 19 three-bedroom units in Calvary Park 1; 33 three-bedroom units in Calvary Park 6; 35 two-bedroom and 23 three-bedroom units in Signal Village 1; and 18 three-bedroom units in De Anza Village 2.

Environmental Issues

- Safe disposal of demolition debris, possibly including asbestos
- Noise associated with construction and demolition activities
- Minor fugitive dust emissions from construction and demolition activities
- Landscape disturbance

Probable Environmental Impacts

There would be no significant environmental impacts associated with project implementation. Some construction and demolition debris would be disposed off site at a landfill permitted to receive such waste. Because the action would replace existing structures with new ones in the same location, no new area would be disturbed. This area is already residential in nature and wildlife common to residential communities would be temporarily displaced from this acreage until the area was revegetated.

F.2.1.17 Project 42782 - Electronic Maintenance Shop

This project supports the 19th Signal Company of the 11th Signal Brigade.

Environmental Issues

New construction in an undisturbed area

Probable Environmental Impacts

If no sensitive biological or cultural resources are affected then the impacts would be minor. The area disturbed would be minimal.

F.2.2 Operation Maintenance Army (OMA) Projects

The projects in this section of this appendix match two projects identified in Table 1.2-5 of section 1.2.3 of the EIS.

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F.2.2.1 Project SR01 - BRAC Area Chapel

This project would result in the construction of a 6,000 square foot chapel in the BRAC area.

Environmental Issues

New construction in an undisturbed area

Probable Environmental Impacts

If no sensitive biological or cultural resources are affected then the impacts would be minor. The area disturbed would be minimal.

F.2.2.2 Project SR02 - Defueling Point Ramada and Utility Improvements

This project would construct a protective 100 square foot ramada over emergency shower facility and store facility operational equipment currently exposed to severe weather conditions. Lighting would be extended from Whitside Road along the access road and around the defueling pad for nighttime defueling operations. The lighting addresses safety issues currently not addressed or satisfied at this time.

F.2.3 Other Potential Projects

The projects in this section are not included in Section 1.2.3 of this EIS but are presented here as potential future programmed construction or renovation activities on the installation.

F.2.3.1 Child Support Center

This project would involve the construction of a new 15,400 square foot Child Support Service Center facility. The project includes an outdoor play area, emergency power generator and site improvements. This activity is included in the SRC and conforms to the LRC.

Environmental Issues

- Habitat modification where facility is built
- Minor amount of construction debris
- Increased traffic

Probable Environmental Impacts

A small amount (slightly over 1/3 of an acre) of habitat would be permanently altered. The species using this habitat would be permanently displaced. Some deterioration of operations due to increased traffic would be likely at the intersection of Smith Avenue and Carter Street.

F.2.3.2 Ammunition Supply Point (ASP)

The construction of a 25,190 square foot Ammunition Supply Point (ASP) on the South Range would include a general purpose magazine, cubicle magazine, ammunition surveillance buildings and an administrative building, inert materials storage area, vehicle holding yard, and two on-site sewage disposal systems. A 1,500 linear foot paved roadway is planned to provide for increased vehicle load to the site and the connection to existing Garden Canyon Road. This project is required in order to eliminate the imminent

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threat to life an property caused by the location of Bonnie Blink residential; subdivision within the surface danger zone of the current ASP. This activity is included in the SRC and LRC.

Environmental Issues

New construction of both the ASP and the paved roadway leading to it

Probable Environmental Impacts

The quantity-safety distance (QSD) arc for the current Ammunition Supply Point (ASP) impinges on the northwest corner of the Bonnie Blink residential area. Construction of a new ASP at the proposed location would alleviate this safety problem. New construction for the buildings and the paved roadway would remove less than 2 acres from its current use. Those 2 acres currently support a limited wildlife presence; this presence on those acres would be permanently removed. Some minor hydrocarbon emissions from the paving of the road would occur.

F.2.3.3 UAV Facility Addition

This proposed project involves the construction of a 55,383 square foot Applied Instruction Facility addition onto the existing West Range training facility to accommodate new Unmanned Aerial Vehicle (UAV) training. New construction would include office/classroom space, engine and airframe maintenance areas, and hazardous materials storage. Supporting facilities would include utilities, electric service with requirements for special power, a paved access road and parking for 25 privately owned vehicles (POVs), 17 buses, and 5 utility vehicles, and site improvements. Also as part of this upgrade to the UAV complex, the Pioneer Runway will be upgraded by the addition of 500 feet to the length, and 25 feet to the width. A UAV specific air traffic control tower, and a 15 square foot apron is also included. The proposed upgrade to the UAV training complex is included in the SRC and conforms to the LRC.

Environmental Issues

- Hazardous materials storage and permitting (Need probable amounts and duration of storage; also need ultimate disposition of materials)
- Building construction
- Expansion of the runway (lengthening and widening) and impacts of increased industrialization on wildlife in the area
- Construction of a paved access road

F.3 CUMULATIVE IMPACTS OF IMPLEMENTING PROJECTS

There are no significant environmental impacts associated with the implementation of the projects described in the previous sections of this appendix. There will be some minor, temporary air quality, waste disposal, and other impacts associated with construction and demolition activities and some minor, but permanent alterations in habitat for those projects which require building on previously undisturbed ground.

Cumulative environmental impacts would be generally beneficial depending on the specific project(s) implemented. At Fort Huachuca, implementing the projects would contribute positively to improved overall safety. Many of the structures that will be rehabilitated or replaced are in generally poor condition, and lack

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appropriate facilities for handicapped access and evacuation in emergency. The newer structures, both residential and operational, will incorporate modern safety and access features. Moving ammunition storage away from existing housing in the cantonment will be a significant improvement in installation safety. Some of the projects would result in improvements to traffic flow.

The use of treated effluent for irrigation purposes and the creation of infiltration basins would improve the efficiency of water use and potentially help recharge the aquifer supplying the San Pedro River. The planned reconstruction of residential facilities and barracks will incorporate more water efficient fixtures than the facilities they are replacing. The water savings from these projects will more than off set the increased water use from such projects as the RV park.

Changes to cumulative impacts to Fort Huachuca's cultural resources resulting from the project construction activities may be potentially somewhat greater than before because of surface disturbance required for several of the projects. However, any such impacts will be mitigated according to law and to protocols approved through consultation with the SHPO.

Implementing the projects will not make any significant contribution to the cumulative regional impacts on biological resources resulting from non-native competition; however, some habitat fragmentation would result from some of the projects. The overall result of implementing the projects to protected biological resources may be an insignificant but positive impact.

Over the short-term, implementing the planned construction projects would generate additional volumes of demolition and construction debris, most of which presents little management concern or potential for increasing cumulative impacts. Those materials like asbestos that do present a concern will be handled according to appropriate protocols in accordance with regulation and installation procedures.

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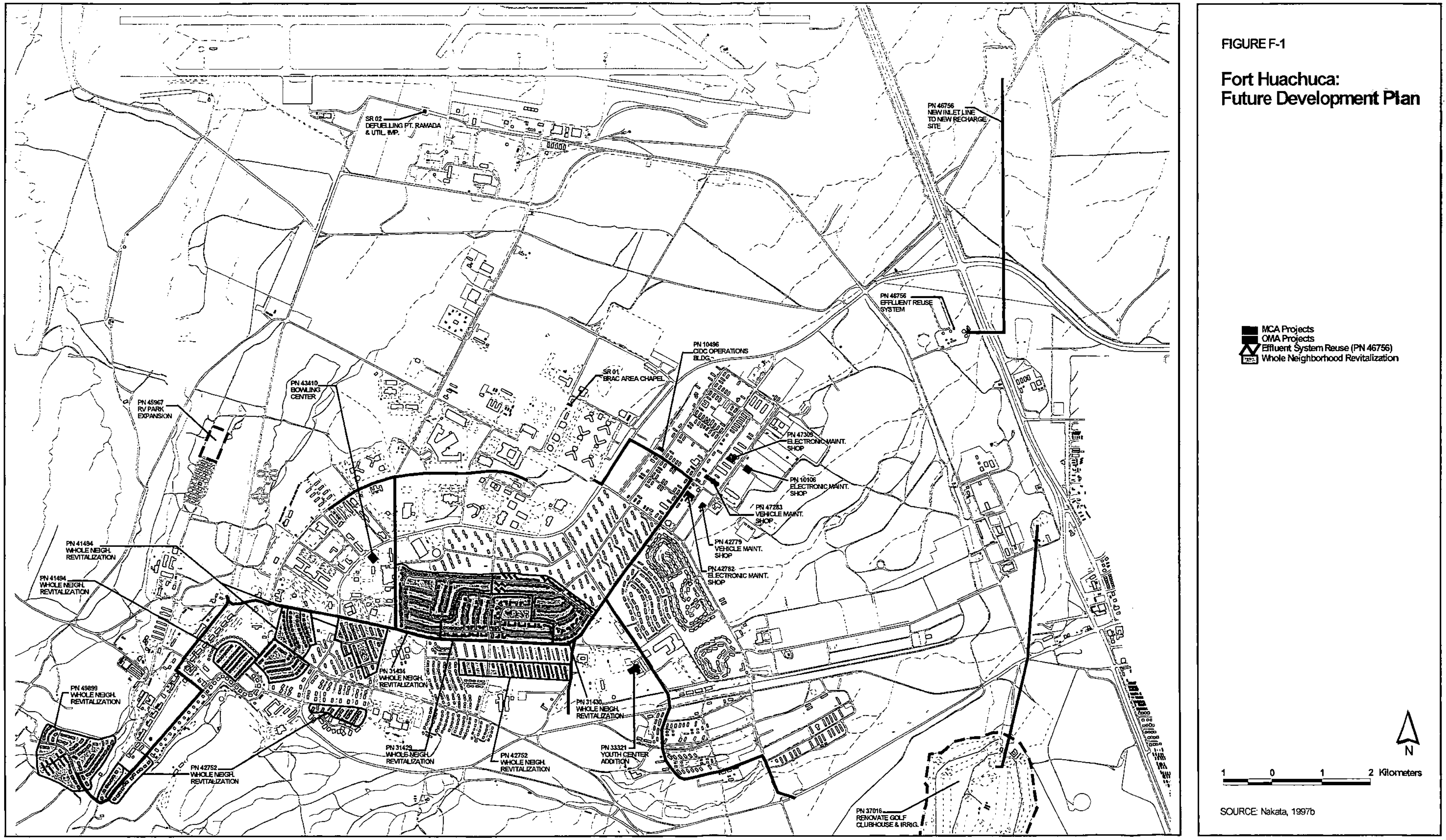

FIGURE F-1

Fort Huachuca: Future Development Plan

SOURCE: Nakata, 1997b

APPENDIX G UTILITIES AND CONSERVATION

This appendix deals with historical utilities usage and the policies and goals adopted by Fort Huachuca to continue to decrease consumption. Conservation measures are identical. Historically, Fort Huachuca has had a weak energy management program. In FY 91 greater emphasis was placed on the program. Since that time there has been a downward trend in energy consumption per square foot of space at Fort Huachuca. In FY 93, Fort Huachuca was rated fourth best in the Army for energy management. The Facilities Energy Resources Management Plan include provisions for revision and upgrade every two years to the plan; a provision for a funded energy management office; and an energy council; and specific energy reduction goals.

G.1 Natural Gas

Natural gas usage over the 7-year period from FY 85 through FY 91 averaged approximately 567,500 million BTUs (Table G-1). From FY 92 through FY 95 the average yearly natural gas usage dropped to 508,266 million BTUs. For the first 11 months in FY 96 only 396,262 million BTUs were used for an annualized seasonally adjusted total of slightly over 410,000 million BTUs (Table G-1).

G.2 Electricity

Electricity usage at Fort Huachuca has remained fairly level over the past several years (see Table G-2). Kilowatt hours (KWH) and demand are both fairly flat but cost per KWH have increased.

G.3 Renewable Energy Systems

Fort Huachuca has experimented with various renewable energy systems over the past 15 years.

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Table G-1. Natural Gas Usage for Fort Huachuca for the Last 12 Fiscal Years (All Numbers are in Millinons BTU [Decatherms])

	FY86	FY87	FY88	FY89	FY90	FY91
OCT	31,983	33,789	21,263	21,427	29,537	27,105
NOV	68,160	55,599	65,460	57,548	59,751	60,515
DEC	74,617	92,742	96,410	90,738	83,222	145,256
JAN	63,225	99,595	93,945	103,409	103,323	78,413
FEB	61,727	86,649	76,004	68,011	80,896	63,717
MAR	82,122	76,713	71,073	53,082	67,963	78,726
APR	29,674	54,929	41,015	23,265	43,988	53,450
MAY	29,703	27,347	22,936	19,470	23,643	23,415
JUN	29,876	19,193	15,159	16,134	15,594	17,309
JUL	30,078	17,135	15,881	16,692	18,834	18,895
AUG	9,222	17,283	15,744	16,443	17,948	17,921
SEP	18,518	20,254	13,643	16,115	13,847	19,441
TOTAL	**528,905**	**601,228**	**548,893**	**502,334**	**586,138**	**604,073**

	FY92	FY93	FY94	FY95	FY96	FY 97
OCT	28,905	15,488	19,897	25,419	18,714	27,957
NOV	64,978	70,240	66,804	71,371	44,970	50,282
DEC	107,851	88,382	84,069	88,987	77,003	62,322
JAN	111,998	100,487	75,274	86,814	61,773	83,452
FEB	81,774	74,982	82,143	64,894	57,516	70,782
MAR	77,606	54,400	57,346	57,833	53,792	45,019
APR	43,263	38,627	38,313	44,814	32,558	39,188
MAY	19,752	16,949	19,141	20,642	14,677	13,785
JUN	17,821	13,920	14,074	11,585	12,814	12,521
JUL	16,319	13,314	14,798	15,030	11,649	12,966
AUG	14,908	10,735	14,202	13,678	11,396	14,089
SEP	15,299	10,777	16,111	13,257	12,216	14,743
TOTAL	**600,474**	**508,301**	**502,172**	**514,324**	**409,078**	**447,106**

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Table G-2. Fort Huachuca Electricity Usage and Costs by Month (October 1984-March 1998) (1 of 3)

Month & Year	Billing Days	KWH	PWR FACTOR	DEMAND (KVA)	AMOUNT	KWH/DAY	¢/KWH	KVAH	Load Factor
Oct-84	30	5,634,600	96.06%	12,631	$297,653.12	187820.00	$0.053	5,865,709	62%
Nov-84	31	5,592,300	94.48%	11,526	$288,484.52	180396.77	$0.052	5,919,030	65%
Dec-84	29	5,535,300	92.81%	11,890	$289,157.09	190872.41	$0.052	5,964,120	67%
Jan-85	31	5,844,000	92.40%	11,903	$300,726.68	188516.13	$0.051	6,324,675	66%
Feb-85	32	5,308,200	92.66%	11,932	$281,067.80	165881.25	$0.053	5,728,686	58%
Mar-85					$274,210.54				
Apr-85	31	5,932,800	90.28%	11,796	$303,517.54	191380.65	$0.051	6,571,555	68%
May-85	29	5,707,500	84.21%	12,823	$303,303.24	196810.34	$0.053	6,777,699	64%
Jun-85	32	7,128,900	82.08%	14,562	$368,723.70	222778.13	$0.052	8,685,307	64%
Jul-85	30	7,127,100	81.25%	14,917	$371,343.49	237570.00	$0.052	8,771,815	66%
Aug-85	29	6,613,500	81.44%	15,085	$353,551.29	228051.72	$0.053	8,120,702	63%
Sep-85	33	7,188,600	82.33%	15,118	$374,936.51	217836.36	$0.052	8,731,447	60%
Oct-85									
Nov-85									
Dec-85	28	5,453,400	85.63%	12,168	$289,044.85	194764.29	$0.053	6,368,562	67%
Jan-86	32	6,115,200	85.30%	12,122	$313,255.60	191100.00	$0.051	7,169,050	66%
Feb-86	32	6,267,000	86.00%	12,117	$318,749.86	195843.75	$0.051	7,287,209	67%
Mar-86	28	5,484,300	86.22%	11,862	$287,922.88	195867.86	$0.052	6,360,821	69%
Apr-86	31	6,307,200	86.04%	12,297	$321,521.63	203458.06	$0.051	7,330,544	69%
May-86	28	5,883,900	85.60%	13,889	$317,314.78	210139.29	$0.054	6,873,715	63%
Jun-86	33	7,668,900	83.79%	15,144	$392,670.00	232390.91	$0.051	9,152,524	64%
Jul-86	30	6,839,436	82.95%	15,153	$362,164.47	227981.20	$0.053	8,245,251	63%
Aug-86	31	7,643,400	82.54%	15,722	$396,209.80	246561.29	$0.052	9,260,237	65%
Sep-86	31	7,236,000	83.51%	14,808	$374,393.26	233419.35	$0.052	8,664,831	66%
Oct-86	29	5,972,400	86.50%	12,779	$312,615.46	205944.83	$0.052	6,904,509	67%
Nov-86	32	6,382,800	86.77%	12,251	$323,998.43	199462.50	$0.051	7,355,999	68%
Dec-86	28	5,721,600	87.04%	12,610	$302,047.33	204342.86	$0.053	6,573,529	68%
Jan-87	31	6,258,900	86.49%	12,646	$322,273.73	201900.00	$0.051	7,236,559	67%
Feb-87	33	6,865,500	86.72%	12,546	$343,989.58	208045.45	$0.050	7,916,859	69%
Mar-87	28	5,886,000	87.05%	13,074	$311,451.87	210214.29	$0.053	6,761,631	67%
Apr-87	30	6,296,700	86.59%	12,640	$323,617.22	209890.00	$0.051	7,271,856	69%
May-87	28	5,784,300	86.37%	12,761	$305,538.86	206582.14	$0.053	6,697,117	67%
Jun-87	34	7,875,000	84.31%	16,197	$407,835.55	231617.65	$0.052	9,340,529	60%
Jul-87	29	7,665,300	83.09%	16,634	$403,489.88	264320.69	$0.053	9,225,298	66%
Aug-87	32	7,902,300	82.97%	16,039	$408,006.15	246946.88	$0.052	9,524,286	64%
Sep-87	31	7,296,300	84.29%	15,507	$381,523.78	235364.52	$0.052	8,656,187	63%
FY87	365	79,907,100	85.68%	16,634	$4,146,387.84	218923.56	$0.052	93,464,359	55%
Oct-87	28	6,256,500	85.33%	14,917	$338,621.16	223446.43	$0.054	7,332,122	62%
Nov-87	32	6,643,200	87.04%	13,990	$346,042.58	207600.00	$0.052	7,632,353	62%
Dec-87	29	5,987,100	87.19%	12,634	$312,030.29	206451.72	$0.052	6,866,728	68%
Jan-88	33	6,770,100	86.55%	12,945	$343,334.94	205154.55	$0.051	7,822,184	66%
Feb-88	31	6,594,600	87.49%	12,760	$335,386.18	212729.03	$0.051	7,537,547	69%
Mar-88	29	6,143,100	87.56%	13,128	$321,287.85	211831.03	$0.052	7,015,875	67%
Apr-88	31	6,388,500	87.18%	13,268	$331,428.30	206080.65	$0.052	7,327,942	65%
May-88	30	6,751,500	86.87%	14,922	$356,744.79	225050.00	$0.053	7,771,958	63%
Jun-88	30	7,601,400	84.64%	16,736	$401,584.59	253380.00	$0.053	8,980,860	63%
Jul-88	31	7,974,300	87.12%	16,488	$413,182.86	257235.48	$0.052	9,153,237	65%
Aug-88	31	8,036,700	87.65%	16,332	$414,416.92	259248.39	$0.052	9,169,082	66%
Sep-88	29	7,298,100	87.93%	16,515	$388,317.87	251658.62	$0.053	8,299,898	63%
FY88	364	82,445,100	86.88%	16,736	$4,302,378.33	226497.53	$0.052	94,909,785	56%
Oct-88	31	8,286,000	91.37%	16,918	$446,181.83	267290.32	$0.054	9,068,622	66%
Nov-88	29	6,376,500	90.64%	13,289	$330,754.25	219879.31	$0.052	7,034,974	69%
Dec-88	29	6,490,800	90.72%	13,669	$337,680.55	223820.69	$0.052	7,154,762	68%
Jan-89	34	7,671,000	90.30%	13,955	$383,492.71	225617.65	$0.050	8,495,017	67%
Feb-89	30	6,917,700	91.18%	14,046	$356,107.70	230590.00	$0.051	7,586,861	68%
Mar-89	28	6,516,300	91.24%	14,098	$341,600.34	232725.00	$0.052	7,141,933	69%
Apr-89	32	7,688,400	90.94%	16,524	$402,315.93	240262.50	$0.052	8,454,366	61%
May-89	30	7,627,800	89.80%	17,494	$406,824.23	254260.00	$0.053	8,494,209	61%
Jun-89	29	8,027,400	87.75%	17,934	$425,503.67	276806.90	$0.053	9,148,034	64%
Jul-89	32	9,068,700	87.00%	18,383	$483,677.69	283396.88	$0.053	10,423,793	64%
Aug-89	31	8,423,100	88.44%	16,719	$450,675.42	271712.90	$0.054	9,524,084	68%
Sep-89	31	8,286,000	91.37%	16,918	$446,181.83	267290.32	$0.054	9,068,622	66%
FY89	366	91,379,700	90.06%	18,383	$4,810,996.15	249671.31	$0.053	101,595,277	57%
Oct-89	30	7,479,853	91.19%	16,248	$409,740.80	249328.43	$0.055	8,202,493	64%
Nov-89	28	6,450,000	91.06%	13,886	$382,356.49	230357.14	$0.059	7,083,242	69%
Dec-89	34	7,604,400	91.21%	13,609	$426,823.85	223658.82	$0.056	8,337,244	68%
Jan-90	30	6,789,000	91.01%	13,825	$395,605.99	226300.00	$0.058	7,459,620	68%
Feb-90	29	6,805,500	91.94%	14,018	$397,798.30	234672.41	$0.058	7,402,110	70%

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Table G-2. Fort Huachuca Electricity Usage and Costs by Month (October 1984-March 1998) (2 of 3)

Month & Year	Billing Days	KWH	PWR FACTOR	DEMAND (KVA)	AMOUNT	KWH/DAY	¢/KWH	KVAH	Load Factor
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$0.058	[illegible]	[illegible]
Apr-90	33	7,841,100	91.80%	13,994	$439,679.40	237609.09	$0.056	8,541,503	71%
May-90	30	7,417,500	90.15%	16,211	$441,979.07	247250.00	$0.060	8,227,953	64%
Jun-90	31	8,604,300	91.37%	18,581	$510,491.59	277558.06	$0.059	9,416,986	62%
Jul-90	30	8,725,800	92.94%	18,898	$517,830.02	290860.00	$0.059	9,388,638	64%
Aug-90	30	7,995,900	93.53%	16,682	$468,614.40	266530.00	$0.059	8,549,022	67%
Sep-90	32	8,572,800	92.85%	17,589	$500,002.35	267900.00	$0.058	9,232,956	63%
FY90	365	90,751,453	91.78%	18,898	$5,271,896.36	248634.12	$0.058	98,844,149	55%
Oct-90	30	7,188,000	94.61%	15,923	$429,066.28	239600.00	$0.060	7,597,506	63%
Nov-90	32	7,153,500	95.01%	13,934	$412,411.13	223546.88	$0.058	7,529,207	67%
Dec-90	30	7,002,300	94.91%	13,634	$421,165.14	233410.00	$0.060	7,377,832	71%
Jan-91	30	6,885,300	94.92%	13,658	$418,954.40	229510.00	$0.061	7,253,793	70%
Feb-91	28	6,424,800	95.15%	13,349	$396,132.14	229457.14	$0.062	6,752,286	72%
Mar-91	31	7,059,600	94.98%	13,685	$451,991.77	227729.03	$0.064	7,432,723	69%
Apr-91	31	7,255,000	95.91%	13,613	$466,781.93	234032.26	$0.064	7,564,383	72%
May-91	29	7,148,400	95.10%	15,007	$473,735.85	246496.55	$0.066	7,516,719	68%
Jun-91	32	8,348,100	96.61%	17,688	$554,279.98	260878.13	$0.066	8,641,031	61%
Jul-91	30	8,832,300	96.01%	18,140	$581,658.02	294410.00	$0.066	9,199,354	68%
Aug-91	29	8,227,500	96.63%	17,996	$551,077.39	283706.90	$0.067	8,514,437	66%
Sep-91	33	8,977,200	96.54%	17,224	$580,479.88	272036.36	$0.065	9,298,943	66%
FY91	365	90,502,000	95.53%	18,140	$5,737,733.91	247950.68	$0.063	94,678,213	57%
Oct-91	30	7,849,800	97.24%	16,868	$528,506.23	261660.00	$0.067	8,072,604	65%
Nov-91	31	7,297,000	94.63%	13,834	$482,088.88	235387.10	$0.066	7,711,085	71%
Dec-91	31	7,322,100	94.99%	13,872	$483,587.92	236196.77	$0.066	7,708,285	71%
Jan-92	29	6,967,200	94.92%	14,696	$475,129.13	240248.28	$0.068	7,340,076	68%
Feb-92	32	7,763,700	94.73%	14,128	$506,992.20	242615.63	$0.065	8,195,609	72%
Mar-92	29	7,130,600	95.86%	14,139	$477,084.06	245882.76	$0.067	7,438,556	72%
Apr-92	30	7,331,700	95.90%	14,716	$492,312.46	244390.00	$0.067	7,645,151	69%
May-92	32	8,352,400	95.13%	17,108	$564,447.54	261012.50	$0.068	8,779,985	64%
Jun-92	30	8,526,600	92.20%	18,047	$582,712.39	284220.00	$0.068	9,247,939	66%
Jul-92	29	8,910,900	93.88%	19,272	$612,696.98	307272.41	$0.069	9,491,798	66%
Aug-92	32	9,554,100	94.75%	18,663	$637,083.88	298565.63	$0.067	10,083,483	67%
Sep-92	30	8,829,300	94.93%	18,591	$602,164.77	294310.00	$0.068	9,300,853	66%
FY92	365	95,835,400	94.93%	19,272	$6,444,806.44	262562.74	$0.067	101,015,425	57%
Oct-92	32	8,896,500	96.12%	17,936	$598,504.54	278015.63	$0.067	9,255,618	65%
Nov-92	29	7,656,300	95.94%	15,225	$511,904.55	264010.34	$0.067	7,980,300	72%
Dec-92	29	7,589,100	95.49%	15,084	$507,423.93	261693.10	$0.067	7,947,534	72%
Jan-93	34	8,563,100	95.20%	15,144	$553,879.56	251855.88	$0.065	8,994,853	69%
Feb-93	30	7,977,900	94.89%	14,876	$523,743.66	265930.00	$0.066	8,407,525	74%
Mar-93	27	7,080,600	94.77%	15,046	$483,270.12	262244.44	$0.068	7,471,352	73%
Apr-93	33	8,616,600	94.78%	15,890	$563,928.46	261109.09	$0.065	9,091,158	68%
May-93	29	8,334,500	95.14%	17,560	$567,266.55	287396.55	$0.068	8,760,248	68%
Jun-93	31	9,621,900	95.62%	20,044	$652,487.40	310383.87	$0.068	10,062,644	65%
Jul-93	31	10,001,100	91.43%	20,252	$673,468.46	322616.13	$0.067	10,938,532	66%
Aug-93	30	9,883,500	95.12%	19,568	$659,954.81	329450.00	$0.067	10,390,559	70%
Sep-93	30	9,048,600	94.49%	18,536	$617,879.25	301620.00	$0.068	9,576,251	68%
FY93	365	103,269,700	94.92%	20,252	$6,913,711.29	282930.68	$0.067	108,876,574	58%
Oct-93	31	8,496,000	94.71%	17,468	$582,455.79	274064.52	$0.069	8,970,542	65%
Nov-93	29	7,492,800	94.33%	14,852	$508,224.11	258372.41	$0.068	7,943,178	72%
Dec-93	34	8,606,400	95.85%	14,552	$558,422.82	253129.41	$0.065	8,979,030	72%
Jan-94	28	7,137,600	95.94%	14,656	$493,808.59	254914.29	$0.069	7,439,650	72%
Feb-94	30	7,915,200	95.35%	15,076	$532,628.38	263840.00	$0.067	8,301,206	73%
Mar-94	29	7,569,600	95.25%	14,724	$512,653.83	261020.69	$0.068	7,947,087	74%
Apr-94	33	8,553,600	94.69%	15,512	$567,422.18	259200.00	$0.066	9,033,266	70%
May-94	29	7,987,200	93.99%	17,868	$585,841.59	275420.69	$0.073	8,497,925	64%
Jun-94	30	9,792,000	91.27%	19,620	$694,570.26	326400.00	$0.071	10,728,607	69%
Jul-94	32	11,217,600	90.20%	21,348	$783,924.86	350550.00	$0.070	12,436,364	68%
Aug-94	30	10,310,400	90.86%	19,792	$722,174.94	343680.00	$0.070	11,347,568	72%
Sep-94	32	10,324,800	91.42%	19,255	$716,988.21	322650.00	$0.069	11,293,809	70%
FY94	367	105,403,200	93.66%	21,348	$7,259,115.56	287202.18	$0.069	112,918,231	56%
Oct-94	29	8,448,000	94.18%	18,571	$616,094.47	291310.34	$0.073	8,970,057	65%
Nov-94	29	7,987,200	95.51%	15,284	$538,194.48	275420.69	$0.067	8,362,685	75%
Dec-94	34	9,235,200	95.40%	15,883	$603,263.06	271623.53	$0.065	9,680,503	71%
Jan-95	28	7,526,400	95.48%	15,528	$519,136.89	268800.00	$0.069	7,882,698	72%
Feb-95	30	8,198,400	95.78%	15,229	$547,480.86	273280.00	$0.067	8,559,616	75%
Mar-95	29	7,795,200	92.72%	14,976	$526,462.25	268800.00	$0.068	8,407,248	75%
Apr-95	33	8,678,400	92.83%	14,799	$566,067.06	262981.82	$0.065	9,348,702	74%
May-95	29	7,929,600	92.15%	15,760	$560,901.65	273434.48	$0.071	8,605,100	72%
Jun-95	32	9,676,800	90.21%	18,255	$674,522.93	302400.00	$0.070	10,726,970	69%

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1 **Table G-2. Fort Huachuca Electricity Usage and Costs by Month (October 1984-March 1998)**
2 **(3 of 3)**

Month & Year	Billing Days	KWH	PWR FACTOR	DEMAND (KVA)	AMOUNT	KWH/DAY	¢/KWH	KVAH	Load Factor
Oct-88	30	16,880,800	96.08%	19,632	$298,893.32	383880.00	$0.036	15,869,498	62%
Aug-95	29	10,646,000	90.89%	20,820	$740,699.66	367103.45	$0.070	11,713,060	73%
Sep-95	32	10,790,400	91.60%	19,921	$747,028.24	337200.00	$0.069	11,779,913	71%
FY95	364	106,972,400	93.17%	20,820	$7,346,772.92	293880.22	$0.069	115,056,048	59%
Oct-95	30	9,043,200	93.34%	18,009	$639,693.59	301440.00	$0.071	9,688,451	70%
Nov-95	33	8,620,800	91.94%	15,091	$566,603.56	261236.36	$0.066	9,376,550	72%
Dec-95	29	7,680,000	89.53%	14,600	$517,613.32	264827.59	$0.067	8,578,130	76%
Jan-96	29	7,545,600	89.57%	14,884	$514,334.43	260193.10	$0.068	8,424,249	73%
Feb-96	30	7,908,800	94.13%	14,531	$526,711.61	263626.67	$0.067	8,401,997	76%
Mar-96	31	8,140,800	95.41%	14,564	$537,713.02	262606.45	$0.066	8,532,439	75%
Apr-96	31	8,332,800	95.04%	15,688	$563,964.59	268800.00	$0.068	8,767,677	71%
May-96	29	9,524,400	92.83%	18,392	$661,585.91	328427.59	$0.069	10,260,045	74%
Jun-96	32	10,502,400	91.81%	19,608	$737,426.33	328200.00	$0.070	11,439,277	70%
Jul-96	30	10,176,000	90.90%	19,440	$719,641.12	339200.00	$0.071	11,194,719	73%
Aug-96	34	10,982,400	91.51%	19,632	$761,860.13	323011.76	$0.069	12,001,311	69%
Sep-96	30	9,523,200	92.54%	18,708	$678,591.33	317440.00	$0.071	10,290,901	71%
FY96	368	107,980,400	92.38%	19,632	$7,425,738.94	293425.00	$0.069	116,955,747	62%
Oct-96	29	8,620,800	93.72%	17,488	$619,977.90	297268.97	$0.072	9,198,464	71%
Nov-96	32	8,390,400	95.95%	14,496	$554,738.27	262200.00	$0.066	8,744,554	75%
Dec-96	31	7,987,200	96.20%	14,548	$536,084.86	257651.61	$0.067	8,302,703	74%
Jan-97	29	7,584,000	96.07%	15,268	$524,689.48	261517.24	$0.069	7,894,244	71%
Feb-97	32	8,640,000	95.95%	14,848	$570,390.56	270000.00	$0.066	9,004,690	76%
Mar-97	27	7,424,000	95.48%	15,484	$519,532.67	274962.96	$0.070	7,775,450	74%
Apr-97	32	8,371,200	95.83%	14,772	$556,820.75	261600.00	$0.067	8,735,469	74%
May-97	32	9,043,200	94.25%	17,172	$637,578.68	282600.00	$0.071	9,594,907	69%
Jun-97	28	8,889,600	92.44%	19,360	$653,960.25	317485.71	$0.074	9,616,616	68%
Jul-97	30	10,022,400	92.02%	19,040	$707,290.00	334080.00	$0.071	10,891,545	73%
Aug-97	32	10,601,600	92.21%	18,924	$735,043.97	331300.00	$0.069	11,497,235	73%
Sep-97	31	10,137,600	92.49%	19,096	$713,611.71	327019.35	$0.070	10,960,753	71%
FY97	365	105,712,000	94.38%	19,360	$7,329,719.10	289621.92	$0.069	112,216,630	62%
Oct-97	29	8,198,400	94.13%	17,020	$593,761.82	282703.45	$0.072	8,709,657	69%
Nov-97	31	7,795,200	94.53%	13,900	$520,363.37	251458.06	$0.067	8,246,271	75%
Dec-97	29	7,372,800	93.87%	14,216	$503,817.98	254234.48	$0.068	7,854,267	75%
Jan-98	31	7,622,400	93.85%	14,040	$513,788.85	245883.87	$0.067	8,121,897	73%
Feb-98	33	8,524,800	94.14%	14,236	$558,743.78	258327.27	$0.066	9,055,449	76%
Mar-98	28	7,200,000	93.84%	13,996	$493,236.56	257142.86	$0.069	7,672,634	77%
Apr-98									
May-98									
Jun-98									
Jul-98									
Aug-98									
Sep-98									

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APPENDIX H SCOPING COMMENTS

This appendix includes written scoping comments from the following agencies:

- U.S. Bureau of Land Management
- U.S. Fish and Wildlife Service
- U.S. Environmental Protection Agency
- Arizona State Parks
- Arizona Game and Fish Department
- City of Bisbee

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FMC003675

United States Department of the Interior
BUREAU OF LAND MANAGEMENT
Safford District Office
711 14th Avenue
Safford, AZ 85546
(602) 428-4040

In reply refer to:
1793 (AZ040)

September 16, 1994

Commander
U.S. Army Garrison
ATTN: ATZS-EHB(Cochran)
Fort Huachuca, AZ 85613

RE: Comments on the Proposed Environmental Impact Statement for Fort Huachuca, AZ.

Dear Commander:

The Bureau of Land Management (BLM) is appreciative of your request for information to be included in determining the scope of issues to be addressed, and for identifying significant issues related to the Environmental Impact Statement as released in the NOI in the Federal register on 19 May 1994. In the context of ecosystem management, the Bureau of Land Management is committed to safeguarding the ecological sustainability of the public's lands. By implementing management that conserves the diversity and protects the integrity of the land, we will ensure that present and future generations continue to derive economic, recreational, social, cultural, and aesthetic benefits from public lands. With that in mind, we have included the following categories of potential issues for you to incorporate in your assessment of actions that would individually or cumulatively impact the region's ecosystem.

Recreation - impacts from Ft. Huachuca related personnel's demand on the area's recreational resources, specifically including: The San Pedro Riparian National Conservation Area; the Empire-Cienega Resource Conservation Area; Bureau of Land Management research natural areas and areas of critical environmental concern.

Visual - impacts to Visual Resource Management objectives from temporary and permanent facility construction related to Ft. Huachuca activities such as: towers, communication facilities, and buildings. Also, impacts associated with light pollution from activities requiring night lighting and/or large reflective surfaces.

Land uses - impacts of planned developments on the landscape as well as impacts from training exercises and land management actions.

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Water - as many of the participants in the public scoping meeting indicated, the direct and indirect impacts to water resources is of great concern and should be thoroughly evaluated including but not limited to: recharge rates; cones of depression; contribution to dewatering (direct and indirect); the significance of water savings from Army policies; surface water quality; urban runoff; lift costs; potential stream flow diminishment and depletions; hydraulic disconnection; riparian impacts; desertification; drainage alterations; recharge and infiltration changes; changes in watershed conditions; potentials for aquifer contamination; ground water quality; changes in depths to groundwater; changes in sediment yields with changes in runoff/erosion; turbidity; encroachment on water courses; soil reflectivities leading to altered precipitation patterns and temperatures; and aquifer over drafting.

Wildlife - impacts to listed or proposed threatened or endangered species and candidate species including assessment of critical habitat. Also, completion of a complete wildlife inventory including an evaluation of migration corridors, species of special concern, and feral released pets.

Vegetation - assessment of changes in landscape including riparian vegetation, ground cover, species diversity, and introduced species influences, including an assessment of impacts from training exercises.

Soils - impacts from permanent construction and ancillary facilities including fire breaks, roads, erosion control structures, pavements, compacted and impermeable surfaces.
Also, an evaluation of hazardous material contamination and the impacts of sand and gravel mining and permit compliance (401 and 404 permits) associated with construction material needs.

Fire Program - assessment of the impacts of natural and man-caused fires including mitigation and contingency plans, especially as relates to the east range.

Cultural - impacts to archaeologic resources from construction, training, and recreation.

Social - assessment of impacts to the economic and cultural diversity of the community including changes expected in schools, cost of living, traffic, crime, fire, and law enforcement needs.

Air Quality - evaluation of transportation and Ft. Huachuca activity related pollution (i.e. dust, smoke, exhaust).

Mitigation of previous actions - summary of actions/activities that have been accomplished to date to mitigate previous actions.

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Overflights - assessment of noise pollution potential, low-level flight frequency flight-path liabilities, restricted areas, policies, and any agreements with agencies for flight restrictions.

Off site training - assessment of impacts to areas outside of Ft. Huachuca's boundary from training exercises.

Electromagnetic interference - impacts to human and wildlife populations including long-term health implications.

Thank you for the opportunity to contribute to the preparation of an Environmental Impact Statement that will address all of the immediate and future needs of the region.

Sincerely,

William T. Civish

William T. Civish
District Manager

FMC003678

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
ARIZONA ECOLOGICAL SERVICES STATE OFFICE
3616 West Thomas Road, Suite 6
Phoenix, Arizona 85019

Telephone: (602) 379-4720 FAX: (602) 379-6629

September 6, 1994

In Reply Refer To:
AESO/ES
2-21-94-I-527

Commander
U.S. Army Garrison
ATTN: ATZS-EHB (Cochran)
Fort Huachuca, Arizona 85613

Dear Sir:

This letter is in response to your August 10, 1994, correspondence requesting comments on a Notice of Intent to prepare an Environmental Impact Statement (EIS) for the master plan update at the United States Army Intelligence Center at Fort Huachuca. The Fish and Wildlife Service (Service) was not able to attend the August 30 scoping meeting in Sierra Vista; however, we are very much interested in being kept apprised of the activities associated with the EIS preparation.

The EIS must consider effects of proposed changes in military activities not only on the environments contained within Fort Huachuca, but also in surrounding areas. Management of water resources at Fort Huachuca and in adjacent communities affects biotic resources and subsurface and surface flows in the San Pedro River. We believe that the master plan must be prepared in the context of the ongoing water rights adjudication process and the comprehensive negotiated settlement that will be prepared for the upper San Pedro Basin.

Fort Huachuca provides habitat for a number of Federally-listed threatened and endangered species, including the lesser long-nosed bat (*Leptonycteris curasoae*) - endangered, American peregrine falcon (*Falco peregrinus anatum*) - endangered, and Mexican spotted owl (*Strix occidentalis lucida*) - threatened, as well as a large number of candidate species (attachment). The San Pedro River from Benson to Hereford is proposed as critical habitat for the southwestern willow flycatcher, a species proposed as endangered. The river is also considered important recovery habitat for four species of Federally-listed fish (see attachment).

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If implementation of a master plan for Fort Huachuca may adversely affect a listed species, the lead Federal action agency is required to initiate formal consultation with the Service pursuant to section 7 of the Endangered Species Act (16 U.S.C. 1531-1544, 87 Stat. 884), as amended (Act). The lead Federal action agency has the responsibility to prepare a biological assessment pursuant to section 7(c) of the Act if the project may adversely affect a listed species and it requires an EIS. If a biological assessment is not required, the lead Federal action agency still has the responsibility to review its proposed activities and determine whether any listed species or species proposed for listing may be affected.

If an action is likely to jeopardize the continued existence of a species proposed for listing, the lead Federal action agency is required to initiate conferencing with the Service. Informal conferencing and consultation may be used to exchange information and resolve conflicts with respect to proposed and listed species, respectively, prior to a written request for formal consultation or conferencing. Preparation of a biological assessment is not required for candidate species. If early evaluation of the project indicates that it is likely to adversely affect a candidate species, you may wish to request technical assistance from this office.

During the assessment or review process, the lead Federal action agency may engage in planning efforts, but may not make any irreversible commitment of resources. Such a commitment could constitute a violation of section 7(d) of the Act. Furthermore, in addition to the consultation requirements outlined in section 7, sections 2(c) and 7(a)(1) require that all Federal agencies use their authorities in furtherance of the purposes of the Act by carrying out programs for the conservation of endangered and threatened species.

Early coordination with the Service on development of alternatives, information collection, and impact analysis for the EIS can avoid potential resource management conflicts that may delay or compromise implementation of the master plan. We will be available to work with your staff in an advisory capacity. For further information, please contact Jim Rorabaugh or Tom Gatz of my staff.

Sincerely,

Sam F Spiller

Sam F. Spiller
State Supervisor

Enclosure

cc: Regional Director, Fish and Wildlife Service, Albuquerque, NM (AES)
Area Manager, Bureau of Reclamation, Phoenix, AZ (Attn: APO-700, Joe Smith)

FMC003680

ENCLOSURE

FEDERALLY LISTED, PROPOSED, AND CANDIDATE SPECIES WHICH MAY OCCUR IN THE SAN PEDRO RIVER BASIN FROM BENSON TO THE INTERNATIONAL BOUNDARY, IN THE SIERRA VISTA AREA, AND AT FORT HUACHUCA[1]

Endangered
Lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*)
American peregrine falcon (*Falco peregrinus anatum*)
Bald eagle (*Haliaeetus leucocephalus*)
Aplomado falcon (*Falco femoralis septentrionalis*)

Threatened
Mexican spotted owl (*Strix occidentalis lucida*)

Proposed Endangered
Southwestern willow flycatcher (*Empidonax traillii extimus*) with proposed critical habitat

Candidate Category 1
Huachuca springsnail (*Pyrgulopsis thompsoni*)
Lemmon's fleabane (*Erigeron lemmonii*)
Blumer's dock (*Rumex orthoneurus*)
Huachuca groundsel (*Senecio huachucanus*)
Huachuca water umbel (*Lilaeopsis schaffneriana* ssp. *recurva*)
Madrean ladies's tresses (*Spiranthes delitescens*)
Cactus ferruginous pygmy owl (*Glaucidium brasilianum cactorum*)
Ramsey Canyon leopard frog (*Rana subaquavocalis*)

Candidate Category 2
Mexican long-tongued bat (*Choeronycteris mexicana*)
Southwestern cave myotis (*Myotis velifer brevis*)
Greater western mastiff-bat (*Eumops perotis californicus*)
California leaf-nosed bat (*Macrotus californicus*)
Arizona shrew (*Sorex arizonae*)
Chiricahua western harvest mouse (*Reithrodontomys megalotis arizonensis*)
Yellow-nosed cotton rat (*Sigmodon ochrognathus*)
Arizona black-tailed prairie dog (*Cynomys ludovicianus arizonensis*)
Loggerhead shrike (*Lanius ludovicianus*)
Ferruginous hawk (*Buteo regalis*)
Northern goshawk (*Accipiter gentilis*)
Apache northern goshawk (*Accipiter gentilis apache*)
White-faced ibis (*Plegadis chihi*)
Northern gray hawk (*Buteo nitidus maximus*)
Mountain plover (*Charadrius montanus*)
(Northern) Buff-breasted flycatcher (*Empidonax fulvifrons pygmaeus*)
Mexican garter snake (*Thamnophis eques*)
Desert tortoise (Sonoran population) (*Gopherus agassizii*)
Canyon spotted whiptail (*Cnemidophorus burti*)
Longfin dace (*Agosia chrysogaster*)

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Desert sucker (*Catostomus [Pantosteus] clarki*)
Santa Rita Mountains chlorochroan bug (*Chlorochroa rita*)
Blue silverspot butterfly (*Speyeria nokomis coerulescens*)
Arizona cave amphipod (*Stygobromus arizonensis*)
Huachuca milk vetch (*Astragalus hypoxylus*)
Coursetia glabbella
Woodland spurge (*Euphorbia plummerae*)
Golden aster (*Heterotheca rutteri*)
Pringle hawkweed (*Hieracium pringlei*)
Lemmon lily (*Lilium parryi*)
Tepic flame flower (*Talinum marginatum*)
Pectis imberbis
Browallia eludens

[1] Although not currently present in the area, the San Pedro River is considered important recovery habitat for the following fish species: spikedace (*Meda fulgida*) - threatened, desert pupfish (*Cyprinodon macularis*) - endangered, loach minnow (*Tiaroga cobitis*) - threatened, razorback sucker (*Xyrauchen texanus*) - endangered, Gila chub (*Gila intermedia*) - category 2 candidate, speckled dace (*Rhinichthys osculus*) - category 2 candidate, Sonora sucker (*Catostomus insignis*) - category 2 candidate, and flannelmouth sucker (*Catostomus latipinnis*) - category 2 candidate.

Endangered and threatened species are protected by Federal law and must be considered prior to project development. Candidate species are those which the Fish and Wildlife Service (Service) is considering adding to the threatened or endangered species list. Category 1 candidates are those for which the Service has enough information to support a proposal to list. Category 2 species are those for which the Service presently has insufficient information to support a proposal to list.

FMC003682

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
ARIZONA ECOLOGICAL SERVICES STATE OFFICE
3616 West Thomas Road, Suite 6
Phoenix, Arizona 85019

Telephone: (602) 379-4720 FAX: (602) 379-6629

September 14, 1994

In Reply Refer To:
AESO/TE
2-21-94-I-527

Commander
U.S. Army Garrison
ATTN: ATZS-EHB (Cochran)
Fort Huachuca, Arizona 85613

Dear Sir:

This correspondence is in response to our September 6, 1994, letter to you in which we provided a species list and comments on a Notice of Intent to prepare an Environmental Impact Statement for the master plan update at the United States Army Intelligence Center at Fort Huachuca. We failed to include two candidate category 2 species, Sonora tiger salamander (*Ambystoma tigrinum stebbinsi*) and the lowland leopard frog (*Rana yavapaiensis*), in the species list and one species, roundtail chub (*Gila robusta*), that is not known to currently occur in the area, but could benefit from future recovery efforts in the San Pedro Riparian National Conservation Area.

We apologize for the oversight and hope that this has not inconvenienced you in any way. In future communications on this project, please refer to consultation number 2-21-94-I-527. If we may be of further assistance, please contact Jim Rorabaugh or Tom Gatz.

Sincerely,

Sam F. Spiller

Sam F. Spiller
State Supervisor

cc: Regional Director, Fish and Wildlife Service, Albuquerque, NM (AES)
Area Manager, Bureau of Reclamation, Phoenix, AZ (Attn: APO-700, Joe Smith)

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UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
ARIZONA ECOLOGICAL SERVICES STATE OFFICE
2321 W. Royal Palm Road, Suite 103
Phoenix, Arizona 85021-4951

Telephone: (602) 640-2720 FAX: (602) 640-2730

December 21, 1994

In Reply Refer To:
AESO/SE
2-21-95-I-087

Mr. Fenton R. Kay
Proteus Corporation
2511 N. Telshor Blvd
Las Cruces, New Mexico 88011

Dear Mr. Kay:

This letter is in response to your November 30, 1994, request for input regarding management plans for federally listed, proposed threatened or endangered, and candidate species on/near Fort Huachuca, an updated species list for Fort Huachuca and vicinity, and any concerns we may have regarding a Sensitive Species Management Plan for Fort Huachuca Military Reservation (Reservation). We appreciate the opportunity to comment on the plan and offer the following comments. We are enclosing a list of federally listed, proposed, and candidate species that may occur on the Reservation and the surrounding area. Please note several changes/additions to the list that you provided. The second enclosure is a copy of the December 14, 1993 Federal Register in regard to three cienega species: Sonora tiger salamander, Canelo Hills ladies'-tresses, and Huachuca water umbel.

The Reservation and nearby dependent communities are using surface and ground water at levels threatening the resources of the San Pedro Riparian National Conservation Area (San Pedro RNCA), one of the very few remaining relatively unaltered riparian systems in the southwestern United States. Diversion of surface water in the Garden Canyon area and groundwater pumping by the Reservation, Sierra Vista, and surrounding communities is intercepting water that normally would contribute to surface base flows in the San Pedro River. Current information indicates that if water use rates remain unchanged and unmitigated, de-watering of the San Pedro River will occur. De-watering of the river is likely to occur if water use increases. Water use in the area is expected to increase as the Reservation increases its responsibilities and staff. Proper management of groundwater resources is essential for the preservation of the San Pedro River as well as the protection of senior water rights held downstream by the Gila River Indian Tribe.

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Mr. Fenton R. Kay 2

A management plan is currently being considered to reintroduce the endangered aplomado falcon into parts of its former range in southeastern Arizona, including Fort Huachuca and the surrounding area. Historical aplomado falcon nesting records indicate that the falcon once nested on the Reservation. Current Reservation habitat remains suitable for a falcon reintroduction effort. In 1992, the Service completed a study to assess environmental contaminant levels in potential prey of the falcon at several proposed reintroduction sites including Fort Huachuca. Organochlorine compound and most heavy metal concentrations were low in small birds which are the falcons preferred prey items. The only contaminant of concern was selenium. The Service study concluded that, if an aplomado falcon reintroduction effort proceeds, reproductive success should be monitored.

The Fish and Wildlife Service (Service) is concerned about the protection of riparian habitats because they are rare and declining in the southwestern United States. Because many plant and animal species only occur or are more abundant in riparian areas, protecting and conserving riparian areas is critical to preserving genetic, species, population, and community diversity throughout Arizona. Maintaining hydrologic and other environmental conditions that support healthy riparian ecosystems is essential to the maintenance of healthy populations of plants, invertebrates, fish, amphibians, reptiles, birds, and mammals. Riparian areas also provide linear corridors critical to migratory species such as neotropical birds, waterfowl, and certain bats. The Service recommends that effects to riparian areas be avoided or mitigated.

In future communications on this project, please refer to consultation number 2-21-95-I-087. If we may be of further assistance, please contact Brenda Andrews or Tom Gatz.

Sincerely,

for

Sam F. Spiller
State Supervisor

Enclosures

cc: Director, Arizona Game and Fish Department, Phoenix, Arizona
Commander, U.S. Army Garrison, ATZS-EHB (Stone)

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FEDERAL STATUS SPECIES WHICH MAY OCCUR AT FORT HUACHUCA AND SURROUNDING AREA
(Includes San Pedro Riparian National Conservation Area)
December 1994

Endangered
Lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*)
Jaguarundi (*Felis yagouaroundi tolteca*)
Ocelot (*Felis pardalis*)
Mexican gray wolf (*Canis lupus baileyi*)
American peregrine falcon (*Falco peregrinus anatum*)
Bald eagle (*Haliaeetus leucocephalus*)
*Northern aplomado falcon (*Falco femoralis septentrionalis*)
*Razorback sucker (*Xyrauchen texanus*)
*Desert pupfish (*Cyprinodon macularius*)

Threatened
Mexican spotted owl (*Strix occidentalis lucida*)
*Spikedace (*Meda fulgida*)
*Loach minnow (*Tiaroga cobitis*)

Proposed Endangered
Southwestern willow flycatcher (*Empidonax traillii extimus*) with proposed critical habitat
Cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*)
Jaguar (*Panthera onca*)

Candidate Category 1
Chiricahua leopard frog (*Rana chiricahuensis*)
Ramsey Canyon leopard frog (*Rana subaquavocalis*)
oSonora tiger salamander (*Ambystoma tigrinum stebbinsi*)
Huachuca springsnail (*Pyrgulopsis thompsoni*)
Lemmon's fleabane (*Erigeron lemmonii*)
Blumer's dock (*Rumex orthoneurus*)
Huachuca groundsel (*Senecio huachucanus*)
oHuachuca water umbel (*Lilaeopsis schaffneriana* ssp. *recurva*)
oMadrean ladies's tresses (*Spiranthes delitescens*)

Candidate Category 2
Mexican long-tongued bat (*Choeronycteris mexicana*)
Southwestern cave myotis (*Myotis velifer brevis*)
Cave myotis (*Myotis velifer*)
Greater western mastiff-bat (*Eumops perotis californicus*)
California leaf-nosed bat (*Macrotus californicus*)
Spotted bat (*Euderma maculatum*)
Allen's (Mexican) big-eared bat (*Idionycteris phyllotis*)
Small-footed myotis (*Myotis ciliolabrum*)
Fringed myotis (*Myotis thysanodes*)

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2

Long-logged myotis (*Myotis volans*)
Yuma myotis (*Myotis yumanensis*)
Big free-tailed bat (*Nyctinomops macrotis*)
Pale Townsend's big-eared bat (*Plecotus townsendii pallescens*)
Arizona shrew (*Sorex arizonae*)
Chiricahua western harvest mouse (*Reithrodontomys megalotis arizonensis*)
Yellow-nosed cotton rat (*Sigmodon ochrognathus*)
Arizona black-tailed prairie dog (*Cynomys ludovicianus arizonensis*)
Loggerhead shrike (*Lanius ludovicianus*)
Ferruginous hawk (*Buteo regalis*)
Northern goshawk (*Accipiter gentilis*)
Apache northern goshawk (*Accipiter gentilis apache*)
White-faced ibis (*Plegadis chihi*)
Northern gray hawk (*Buteo nitidus maximus*)
Mountain plover (*Charadrius montanus*)
(Northern) Buff-breasted flycatcher (*Empidonax fulvifrons pygmaeus*)
Mexican garter snake (*Thamnophis eques*)
Desert tortoise (Sonoran population) (*Gopherus agassizii*)
Lowland leopard frog (*Rana yavapaiensis*)
Canyon spotted whiptail (*Cnemidophorus burti*)
Longfin dace (*Agosia chrysogaster*)
Desert sucker (*Catostomus [Pantosteus] clarki*)
*Gila chub (*Gila intermedia*)
*Roundtail chub (*Gila robusta*)
*Speckled dace (*Rhinichthys osculus*)
*Flannelmouth sucker (*Catostomus latipinnis*)
*Sonora sucker (*Catostomus insignis*)
Santa Rita Mountains chlorochroan bug (*Chlorochroa rita*)
Blue silverspot butterfly (*Speyeria nokomis coerulescens*)
Arizona cave amphipod (*Stygobromus arizonensis*)
Huachuca milk vetch (*Astragalus hypoxylus*)
Coursetia glabbella
Woodland spurge (*Euphorbia plummerae*)
Golden aster (*Heterotheca ruteri*)
Pringle hawkweed (*Hieracium pringlei*)
Lemmon lily (*Lilium parryi*)
Tepic flame flower (*Talinum marginatum*)
Texas purple spike (*Hexalectris warnockii*)
Pectis imberbis
Browallia eludens

* Denotes species with potential habitat for recovery.
o Denotes species for which 90-day findings on petitions to list has been published (58 FR 65325).

FMC003688

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, Ca. 94105-3901

June 30, 1994

Major General Stewart
Commanding Officer, U.S. Army Garrison
Fort Huachuca, Arizona 85613-6000

ATTN: ATZS-EHB (Mr. Tom Cochran)

Dear General Stewart:

The Environmental Protection Agency (EPA) has received the Notice of Intent (NOI) to prepare a Programmatic Environmental Impact Statement (PEIS) for the Master Plan Update at United States Army Intelligence Center and Fort Huachuca, Arizona. Our review is based on the National Environmental Policy Act (NEPA), and the Council on Environmental Quality (CEQ) NEPA Implementation Regulations (40 CFR Parts 1500-1508), and Section 309 of the Clean Air Act (CAA).

The United States Army Intelligence Center (USAIC) and Fort Huachuca provide program development, testing facilities and support to all branches of the armed services. The Updated Master Plan would prepare the USAIC and Fort Huachuca to conduct realistic and effective training into the next century by formalizing priorities for development of training ranges, maneuver areas, and facilities. The proposed Updated Master Plan is reviewed at a programmatic level because several action components would require project-level environmental review, including environmental impact statements, throughout the Plan's twenty-year implementation period.

Alternatives to the proposed action include a no action alternative in which installation operations and development would continue at current levels; an alternative in which the Master Plan and component plans would be implemented and current development and testing and training levels would be maintained; and, an alternative in which development and testing program would be expanded, and construction above the level outlined in the master plan would be implemented to meet total requirements. The installation master plan for intelligence development and testing programs and training will be evaluated as occurrences under each of the above alternatives.

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The DPEIS should discuss potential impacts to biological resources, including threatened or endangered species, wetlands and aquatic habitats, water quality, land use compatibility, noise, traffic, air quality, public health and safety, and cultural resources. Cumulative impacts should be analyzed in context with other posed and pending development on- and off-site in the region of the U.S. Army Intelligence Center and Fort Huachuca. EPA encourages the Army to use this review process to develop a range of alternatives with maximum consideration for environmental quality, including specific measures to incorporate pollution prevention and conservation measures into the project. EPA strongly encourages the Army to recognize, preserve and enhance the region's positive environmental attributes as much as possible.

Federal and State environmental and resource agencies should be included in the Master Plan Updating process. Given the complex issues facing the proposed Actions at Intelligence Center and Fort Huachuca, it is important that local communities clearly understand the potential environmental constraints and consequences of such an actions.

We appreciate the opportunity to comment on the proposed project and request that three copies of the Draft Environmental Impact Statement (DPEIS) be sent to this office (mail code E-3-1) at the same time it is filed with our Washington, D.C. office. Please address the documents to my attention. We also request notification of any meetings to be held regarding this project. If you have any questions, please contact me at (415) 744-1574 or Jeff Philliber of my staff at (415) 744-1570.

Sincerely,

Edward E. Fox for

David J. Farrel, Chief
Environmental Review Section
Office of Federal Activities

2200HCHA.NO.JP
Attachments (2)

FMC003690

EPA SCOPING COMMENTS, MASTER PLAN UPDATE AT UNITED STATES ARMY INTELLIGENCE CENTER AND FORT HUACHUCA, ARIZONA, JUNE 1994

AIR QUALITY COMMENTS

1. The DPEIS should provide information regarding the region's current air quality (attainment) status and the proposed project's impacts on that status. Generation of criteria pollutants at the U.S. Army Intelligence Center and Fort Huachuca expected under the proposed Master Plan Update should be analyzed in the context of that attainment status. The DPEIS should include a complete examination of the following:

- existing air quality conditions, problems and planning;
- potential air quality impacts from the proposed action;
- conformity with the State Implementation Plan (SIP), if applicable;
- air quality mitigation measures; and,
- project alternatives, including alternatives that minimize air quality impacts.

Pursuant to the requirements of Section 176(c) of the Clean Air Act, 42 U.S.C. Section 7506(c), Federal agencies are prohibited from engaging in or supporting in any way an action or activity that does not conform to an applicable State implementation plan. Conformity to an implementation plan means conformity to an implementation plan's purpose of eliminating or reducing the severity and number of violations of the national ambient air quality standards and achieving expeditious attainment of such standards. EPA has promulgated regulations at 58 Federal Register 63214 (November 30, 1993) implementing Section 176(c). Among other things, these regulations establish de minimis levels for actions requiring conformity determinations, exempt certain actions from conformity determinations, and create criteria and procedures that Federal agencies must follow for actions required to have conformity determinations. the Army should review these regulations and discuss their applicability in the DPEIS. If the Army has any questions regarding these or other conformity requirements, please contact Bob Pallarino of the EPA Air and Toxics Division at (415) 744-1212.

WETLANDS AND WATER QUALITY RESOURCES

1. If the proposed Master Plan Update would affect U.S. waters or wetlands, the U.S. Army Corps of Engineers should be contacted to determine the need for a Section 404 discharge permit, as appropriate. If a permit is required, EPA will review the proposed project for compliance with the Federal Guidelines (40

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CFR 230) promulgated pursuant to Section 404(b)(1) of the Clean Water Act (CWA). In keeping with the national goal of "no net loss" of wetlands, the DPEIS should consider alternatives that will preserve wetland resources.

To comply with the Guidelines, the proposed project must meet all of the following criteria:

- There is no practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem (40 CFR 230.1(a)).

- The proposed project will not cause or contribute to significant degradation of waters of the United States, including wetlands (40 CFR 230.1(c)). Significant degradation includes loss of fish and wildlife habitat, including cumulative losses.

- The proposed project does not violate water quality standards, toxic effluent standards, or jeopardize the continued existence of federally listed species or their critical habitat (40 CFR 230.10(b)).

- All appropriate and practicable steps are taken to minimize adverse impacts on the aquatic ecosystem (i.e., mitigation) (40 CFR 320.10(d)). This includes incorporation of all appropriate and practicable compensation measures for avoidable losses to waters of the United States, including wetlands.

To characterize baseline conditions within the project area, the DPEIS should include maps, text, and tables that feature areas occupied by wetlands, aquatic systems, and non-wetland riparian habitat. Direct, indirect and cumulative impacts to these resources should also be fully described in the DPEIS.

If wetlands are affected, the DPEIS should contain a mitigation plan that assures no net loss of wetland or riparian functions, values, and acreage. Areas that may already qualify as wetland/riparian habitat are not generally considered by EPA to be suitable for use as mitigation areas. Although encouraged by EPA, enhancement of existing wetland and riparian habitat is not in itself sufficient mitigation to meet the "no net loss" goal.

2. The DPEIS should ensure that the proposed Updated Master Plan would not affect the Department of Defense's obligation to meet water quality standards. The DPEIS should describe existing

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EPA SCOPING COMMENTS, MASTER PLAN UPDATE AT UNITED STATES ARMY INTELLIGENCE CENTER AND FORT HUACHUCA, ARIZONA, JUNE 1994

treatment facilities and National Pollutant Discharge Elimination System (NPDES) permits and should discuss the need for additional facilities and permits to meet the needs of the proposed project.

BIOLOGICAL RESOURCES COMMENTS

1. The DPEIS should address whether threatened, endangered or other special status species would be affected by the proposed Master Plan Update. The Army should conduct all necessary field surveys, and consult with all appropriate state and federal agencies, including the U.S. Fish and Wildlife Service, in determining the range of species that could be affected by the proposed action.

2. The DPEIS should indicate whether the U.S. Army Intelligence Center and Fort Huachuca are in close proximity to sensitive biological habitats. The DPEIS should include a description of such areas in relation to the installations, and determine the potential effects of the proposed Master Plan Update on such areas (e.g. noise, air quality, etc.). The DPEIS should determine whether impacts to on-site biotic communities and habitat also could affect biotic communities that may exist on or in the vicinity of the site.

PUBLIC SERVICES AND UTILITIES COMMENTS

1. The DPEIS should include a survey of regional landfill capacities which would be available to the U.S. Army Intelligence Center and Fort Huachuca, and an analysis of net increase or decrease in solid waste generation that would result from the proposed Master Plan Update. The impacts associated with any substantial increases in solid waste generation should be assessed in relation to available landfill capacity. Pursuant to Executive Order 12873, EPA encourages the Army to incorporate source reduction, recycling and reuse elements into its Master Plan Update and its related actions (e.g., provide recycling depositories for new developments, if applicable).

EPA considers this Army Action as an opportunity to establish mandatory waste prevention and recycling programs within the development process. The Army should use this action as a means to promote positive recycling efforts in the Intelligence Center and Fort Huachuca Area. The DPEIS should also discuss recycle options for any demolition and construction materials that would result from the proposed Master Plan Update.

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EPA SCOPING COMMENTS, MASTER PLAN UPDATE AT UNITED STATES ARMY INTELLIGENCE CENTER AND FORT HUACHUCA, ARIZONA, JUNE 1994

2. The DPEIS should include a discussion of pollution prevention and energy conservation opportunities related to the proposed Master Plan Update, pursuant to Executive Orders 12856 and 12902, respectively. EPA's position is that such opportunities should be integrated into the analysis as part of the physical and economic aspects of the proposed action.

HAZARDOUS MATERIALS COMMENTS

1. The DPEIS should identify the U.S. Army Intelligence Center and Fort Huachuca's hazardous materials storage, disposal and contamination history as relevant to the siting of future uses under the proposed Master Plan Update.

2. The DPEIS should include detailed descriptions of project components that could release contaminated or hazardous substances into the aquatic and terrestrial environment. Such substances could include petroleum-based products, explosive ordinance and lead fragments, battlefield chemicals, household chemicals, toxic airborne contaminants, etc. In addition, project-related disturbances of facilities containing friable asbestos, PCB's and lead (e.g., lead-based paint) should be noted and discussed.

NEPA COMMENTS

1. In keeping with the Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (EO 12898), the DPEIS should describe the measures taken by the Army to: 1) fully analyze the environmental effects of the proposed Federal action on minority communities and low-income populations, and 2) present opportunities for affected communities to provide input into the NEPA process. The intent and requirements of EO 12898 are clearly illustrated in the President's February 11, 1994 Memorandum for the Heads of all departments and Agencies, attached.

2. The DPEIS should include an analysis of potential cumulative effects in the region surrounding the U.S. Army Intelligence Center and Fort Huachuca. According to 40 CFR 1508.7, "(c)umulative impacts can result from individually minor but collectively significant actions taking place over a period of time." The DPEIS cumulative impacts analysis should include "the incremental impact of the action when added to other past, present and reasonably foreseeable future actions." A

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description of all planned, pending and approved projects in the region should be presented along with a map illustrating the locations of those projects. The incremental effects of the proposed Master Plan Update should then be added to the expected development effects in the region to determine the total cumulative impact of those projects.

3. EPA recommends that the Army, in accordance with 40 CFR 1502.14(e) and 1505.2(b), identify a Preferred Alternative and an Environmentally Preferable Alternative (these may or may not be the same Alternative) in the DPEIS. EPA strongly encourages the Army to focus on developing a Preferred Alternative that best balances environmental quality with the fulfillment of Department of Defense objectives. Such an alternative should protect site-specific natural resources, maintain regional environmental quality for such resources as air quality and water resources.

4. Mitigation is usually required to reduce or eliminate adverse environmental impacts. Therefore, it is important that the Army describe proposed mitigation measures in the DPEIS. These measures would then provide the basis for specific commitments carried forward to the FPEIS and the Record of Decision (ROD). We believe the order of preference for mitigation should be: avoid, minimize, rectify, and compensate. This guidance should be an integral part of the Army planning process.

GENERAL COMMENTS

1. The DPEIS should define significance criteria as they are applied to the impact analysis. Impacts should be clearly stated along with their level-of-significance. Mitigation Measures should correspond to specific impacts.

2. The DPEIS should discuss the need for the proposed Master Plan Update.

3. The DPEIS should clearly define and describe "baseline" conditions. Baseline conditions should be those conditions that exist at the U.S. Army Intelligence Center and Fort Huachuca immediately prior to implementation of the Master Plan Update. Positive and negative impacts should be assessed by comparing future conditions projected under the proposed Action to those baseline conditions established in the DPEIS. Baseline conditions should be used consistently throughout the document as a basis for impacts analysis.

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EPA InSight POLICY PAPER

This supplement to EPA InSight contains up-to-date policy information from the Administrator/Deputy Administrator to all EPA employees.

MARCH 1994

EPA-175-N-94-001

EXECUTIVE ORDER #12898 ON ENVIRONMENTAL JUSTICE

Below is a memorandum from President Clinton to the heads of all departments and agencies on "Executive Order on Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" – February 11, 1994:

Today I have issued an Executive Order on Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. That order is designed to focus Federal attention on the environmental and human health conditions in minority communities and low-income communities with the goal of achieving environmental justice. That order is also intended to promote nondiscrimination in Federal programs substantially affecting human health and the environment, and to provide minority communities and low-income communities access to public information on, and an opportunity for public participation in, matters relating to human health or the environment.

The purpose of this separate memorandum is to underscore certain provisions of existing law that can help ensure that all communities and persons across this Nation live in a safe and healthful environment. Environmental and civil rights statutes provide many opportunities to address environmental hazards in minority communities and low-income communities. Application of these existing statutory provisions is an important part of this Administration's efforts to prevent those minority communities and low-income communities from being subject to disproportionately high and adverse environmental effects.

I am therefore today directing that all department and agency heads take appropriate and necessary steps to ensure that the following specific directives are implemented immediately:

In accordance with Title VI of the Civil Rights Act of 1964, each Federal agency shall ensure that all programs or activities receiving Federal financial assistance that affect human health or the environment do not directly, or through contractual or other arrangements, use criteria, methods, or practices that discriminate on the basis of race, color, or national origin.

Each Federal agency shall analyze the environmental effects, including human health, economic and social effects, of Federal actions, including effects on minority communities and low-income communities, when such analysis is required by the National Environmental Policy Act of 1969 (NEPA), 42 U.S.C. section 4321 et seq. Mitigation measures outlined or analyzed in an environmental assessment, environmental impact statement, or record of decision, whenever feasible, should address significant and adverse environmental effects of proposed Federal actions on minority communities and low-income communities.

Each Federal agency shall provide opportunities for community input in the NEPA process, including identifying potential effects and mitigation measures in consultation with affected communities and improving the accessibility of meetings, crucial documents, and notices.

The Environmental Protection Agency, when reviewing environmental effects of proposed action of other Federal agencies under section 309 of the Clean Air Act, 42 U.S.C. section 7609, shall ensure that the involved agency has fully analyzed environmental effects on minority communities and low-income communities, including human health, social, and economic effects.

Each Federal agency shall ensure that the public, including minority communities and low-income communities, has adequate access to public information relating to human health or environmental planning, regulations, and enforcement when required under the Freedom of Information Act, 5 U.S.C. section 552, the Sunshine Act, 5 U.S.C. section 552b, and the Emergency Planning and Community Right-to-Know Act, 42 U.S.C. section 11044.

* * *

The following is a statement from EPA Administrator Carol Browner on the Environmental Justice Executive Order:

For too long, low-income communities and minority communities have borne a disproportionate burden of modern industrial life. Today's Executive Order seeks to bring justice to these communities.

All Americans deserve to be protected from pollution – not just those who can afford to live in the cleanest, safest communities. All Americans deserve clean air, pure water, land that is safe to live on, food that is safe to eat.

Last April, on Earth Day, President Clinton called on federal agencies to ensure equal environmental protection to all Americans. Today's Executive Order means that federal agencies will address environmental injustice – past, present, and future.

We will develop strategies to bring justice to Americans who are suffering disproportionately – farm workers who are exposed to high-risk pesticides, children who are exposed to lead paint in old buildings, people who fish in polluted waters; those who live near hazardous waste incinerators.

We will develop strategies to ensure that low-income and minority communities have access to information about their environment – and that have an opportunity to participate in shaping government policies that affect their health and their environment.

The Clinton Administration's proposal to reform our Superfund law speaks to these concerns – by increasing public participation in Superfund decision-making.

The President has asked me to convene an interagency working group to begin to implement the Executive Order.

EPA's Role

In 1992, EPA created the Office of Environmental Equity to address environmental impacts affecting minority and low income communities. The Office's functions include:

- coordinating with other federal agencies on environmental equity issues;
- providing communication, outreach, education, and training for the public;
- providing technical and financial assistance to outside groups; and
- serving as a central repository of environmental equity information.

Your Role

• LEARN about the community in which you are working. How familiar are you with its population? For example, are there people who don't speak English well, people who can't read, or people who are shut in? Will work schedules keep people from attending community meetings?

32 million (14 percent) of the people in the U.S. speak a language other than English at home. For example in California, 5.5 million people speak Spanish and 0.6 million speak Chinese at home. Over 17 million (8 percent) of people living in the U.S. speak Spanish at home.

Are important announcements and information such as fish advisories and Superfund site fact sheets available to non-English speakers? What is the educational level of people in the communities? How diverse is the community?

• CONSIDER children. Children are especially vulnerable to harm from toxic substances and may be exposed through normal play.

Intergenerational equity means that younger or older generations, or future generations, should not bear a greater environmental burden. Is there a relatively high population of children in the neighborhood? Do children play outdoors where they may come in contact with contaminated soil and water? Do cleanup remedies suggest unrealistic goals such as prohibiting children from playing outdoors?

• UNDERSTAND cultural diversity. Many cultural groups, e.g. African Americans, Native Americans, and Vietnamese, depend upon fishing to augment their diets either because of poverty or tradition.

Of the 250 million Americans: 49 million (20 percent) are African Americans, Native Americans, and Asian Americans. 22 million (9 percent) are Hispanic Americans.

Do people garden and rely upon food they grow in soil that is or may become contaminated? How do they water their garden?

People may be exposed to toxics through multiple sources. Do some people receive additional exposure to toxics at work or because they live in older housing?

• REALIZE that poverty severely limits options and opportunities. Low income groups cannot always move away from undesirable places, do not have adequate health care to identify environmental disease, and may suffer more exposure.

Many low income persons do not own vehicles and do not have access to county, state, or federal parks for recreation. Not only do they miss out on quality outdoor experiences, they fish, swim and play in areas that are contaminated.

Are they more exposed to auto emissions even though they don't own vehicles because they live in inner cities, close to heavily traveled streets and freeways?

This pamphlet is for EPA employees who would like to know more about environmental equity. If you work in communities, support those that do, write regulations which affect people or communities, or answer an EPA hotline, you have a role in equity.

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ARIZONA STATE PARKS

1300 W. WASHINGTON
PHOENIX, ARIZONA 85007
TELEPHONE 602-542-4174

September 13, 1994

Tom Cochran
Chief, Environmental and
Natural Resources Division
United States Army Intelligence Center
and Fort Huachuca
Fort Huachuca, AZ 85613-6000

RE: Fort Huachuca, Programmatic EIS, DOD-Army

Dear Mr. Cochran:

Thank you for notifying us about Notice of Intent to prepare a programmatic draft Environmental Impact Statement (EIS) for the operation of Fort Huachuca. Our office would like to assist the Army in the preparation of this document to ensure that it adequately addresses the full range of issues that might affect cultural resources under the jurisdiction or control of Fort Huachuca.

Of course, the EIS should address the continued preservation and maintenance of buildings within the National Historic Landmark (NHL). It should also address the need to evaluate and maintain other historic buildings and structures at the Fort including facilities constructed in the 1930s and during World War II. Fort Huachuca probably has the best extant remains of World War II buildings in Arizona. In addition, I believe that the Fort needs to recognize its somewhat unique Afro-American military heritage and those facilities associated with that period in its history. The draft EIS might also want to identify the need to evaluate the potential for significant Cold War era facilities. In sum, the Fort should identify and evaluate all its historic buildings, structures and objects.

As you know, we now have an agreement covering the repair and replacement of windows within the NHL. I recommend that you consider the need for a Programmatic Agreement dealing with the maintenance and repair of all historic facilities at the Fort.

There is a wide range of prehistoric archaeological resources within Fort Huachuca ranging from PaleoIndian and Archaic period sites to protohistoric sites. The Fort contains relatively rare examples of prehistoric villages (the Garden Canyon site) in your section of the state and a variety of ceramic period archaeological resources. The continued protection of such resources is critical.

Very little has been done to identify the potential for Traditional Cultural Properties (TCPs) within Fort Huachuca. I recommend that the Fort consult with local Native American groups to determine if any TCPs exist within land controlled by the Fort.

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Tom Cochran
September 13, 1994
Page 2

The EIS should identify the need for a cultural resources management plan geared towards the identification, evaluation and protection of all of the significant cultural resources at the site. The EIS should also specify the consultation procedures needed with our office, the Advisory Council on Historic Preservation, Native American groups and other interested parties.

We look forward to reviewing the draft EIS and appreciate your continued cooperation with this office in complying with the historic preservation requirements for federal undertakings. If you have any questions, please contact me at (602) 542-7137 or 542-4009.

Sincerely,

Robert E. Gasser
Compliance Coordinator
State Historic Preservation Office

FMC003701

THE STATE OF ARIZONA

GAME & FISH DEPARTMENT

2221 West Greenway Road, Phoenix, Arizona 85023-4399 (602) 942-3000

555 N. Greasewood Rd., Tucson, AZ 85745 (602) 628-5376

Governor
Fife Symington
Commissioners:
Elizabeth T. Woodin, Tucson, Chairman
Arthur Porter, Phoenix
Nonie Johnson, Snowflake
Michael M. Golightly, Flagstaff
Herb Guenther, Yuma
Director
Duane L. Shroufe
Deputy Director
Thomas W. Spalding

September 15, 1994

Commander
U.S. Army Garrison
ATTN: ATZS-EHB (Tom Cochran)
Fort Huachuca, Arizona 85613

Re: Scoping Comments; Programmatic Draft Environmental Impact Statement (PDEIS) for Fort Huachuca, Arizona

Dear Commander:

The Arizona Game and Fish Department (Department) requests the following scoping comments be addressed in the above-referenced PDEIS.

1. Desert washes provide important wildlife movement corridors, connecting habitats on the Fort with adjacent public and private lands. The PDEIS should address impacts of proposed activities on these habitat corridors and on wildlife movements. Mitigation methods which should be considered include, but should not be limited to, establishing buffer zones and preparing an urban development plan in cooperation with the City of Sierra Vista.

2. Encounters between people and wildlife on the Fort may result in property damage or personal injury. Future development will only increase the number and frequency of human/wildlife conflicts, both on the Fort and off. Education programs should be initiated to assist military personnel and their families to prevent or resolve wildlife conflicts.

3. With recent reductions in staff, the Game Branch at Fort Huachuca has dropped from a staff of 5 to just 1 biologist. The PDEIS should evaluate the Fort's ability to satisfy federal environmental requirements and agency standards with only one staff biologist. Furthermore, it should evaluate the feasibility of planning and implementing proposed wildlife management projects on the Fort (e.g., Partners in Flight, Legacy Grants, etc).

4. The role and importance of fire in maintaining and improving wildlife habitat should be addressed in the PDEIS. We strongly encourage the Fort to prepare a fire management plan.

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Commander
September 16, 1994
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Unfortunately, military operations have caused some areas to burn too frequently, while other areas that would benefit from fire have remained unburned. The cumulative effects of repeated burning should be considered in the PDEIS, as well as impacts associated with construction and use of firebreaks.

5. Over 70 percent of Arizona's threatened vertebrate species are either closely associated with or completely dependent upon riparian habitat. The Department recognizes riparian habitats as areas of critical environmental importance to wildlife and fisheries, and is directed to actively encourage management practices that will result in maintenance of riparian habitat. Arizona State Governor Executive Order No. 91-6 also recognizes the critical nature of riparian areas. We strongly recommend the PDEIS evaluate impacts to all riparian habitats on the Fort and in the watershed which may result from past, current and future military operations and base expansion. To assist the Fort in this effort, we recommend they inventory and monitor riparian areas, and establish buffer corridors as needed to protect sensitive habitats. In addition, the PDEIS should identify degraded riparian areas that would benefit from restoration efforts.

6. We recommend the Fort contact the Department's Heritage Data Management System to obtain the most current list of special status species documented as occurring in the vicinity of Fort Huachuca. In addition, the PDEIS should consider possible impacts to sensitive habitats (as defined by the Department), and any impacts to suitable but apparently unoccupied habitat for special status species.

7. The PDEIS should consider possible impacts to bat habitat. We are especially concerned about maintaining and improving habitat for lesser long-nosed bat. Impacts of nighttime human activity in or adjacent to agave stands, as well as effects of low-flying aircraft over agave stands, should be addressed. Caves, rock outcroppings, adits, mines and other structures provide roosting sites for a variety of bats, and management of these features should be considered in the PDEIS.

8. We are also concerned about maintaining and improving habitat for pronghorn on the Fort. The PDEIS should consider the role and value of fire in maintaining quality habitat for pronghorn.

9. In accordance with the MOU between the Department and Department of Defense, we conduct aerial surveys for wildlife

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September 16, 1994
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over the Fort in order to monitor the health and condition of big game populations and establish harvest levels. We recommend the PDEIS identify the importance of aerial wildlife surveys, and address any impacts that airspace restrictions and increasing air traffic may have on the Department's ability to conduct aerial surveys.

10. The PDEIS should address hunting and wildlife viewing opportunities on the Fort. What additional restrictions may be placed on these activities as a result of future expansion of the Fort?

We appreciate the opportunity to provide these comments, and we look forward to continuing to participate in the development of the PDEIS. If we can provide any additional information, please contact me at 628-5376.

Sincerely,

Glenn Frederick

Glenn Frederick
Habitat Specialist
Tucson Regional Office

GPF:gpf

cc: John Millican, District Wildlife Manager
Ronald Olding, Region V Wildlife Program Manager
Ron Christofferson, Project Evaluation Coordinator

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FMC003705

City of BISBEE
118 ARIZONA STREET • BISBEE, ARIZONA 85603
(602) 432-5446 • FAX (602) 432-5858

September 8, 1994

Commander
U.S. Army Garrison
ATTN: ATZS-EHB (Cochran)
Fort Huachuca, AZ 85613

Subject: Comments on proposed EIS for Fort Huachuca

The following comments are being forwarded in accordance with the Notice of Intent to prepare the subject EIS.

Of main concern to the City of Bisbee are the existing and future impacts to housing, water, and the economic base of the city. As this study unfolds we would like for the consultant to consider how activities from the Fort would impact the City of Bisbee and how negative impacts would be mitigated (i.e. impacts to housing). Positive impacts should also be noted.

As the EIS progresses and significant issues are quantified, the City feels that any depletion of the water table which effects the water supply for Bisbee should not be considered. Any plans the Fort may wish develop to compete as a major water supplier in association with the City would be supported by this community (Joint Partnership). The Arizona Water Company is the sole supplier of water in the Bisbee area.

We understand that the Fort will not provide additional housing on base to its soldiers. If this the case where will the demand for additional housing be met? The City of Sierra Vista may be able to meet some of this need, but if an alternative location is sought, the City would be interested in assisting. The last significant issue we would like for you to consider are the socio/economic impacts to the City of Bisbee. If the Fort were to expand what are the immediate and future impacts? What are the alternative scenarios planned by the Fort? We would like to see that practical alternatives are used and that significant impacts are mitigated to a level of insignificance.

Sincerely,

Rubin Mejia

Rubin Mejia
Planning & Zoning Administrator

cc: L.H. Hamilton

C:\FORT-EIS.LTR

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