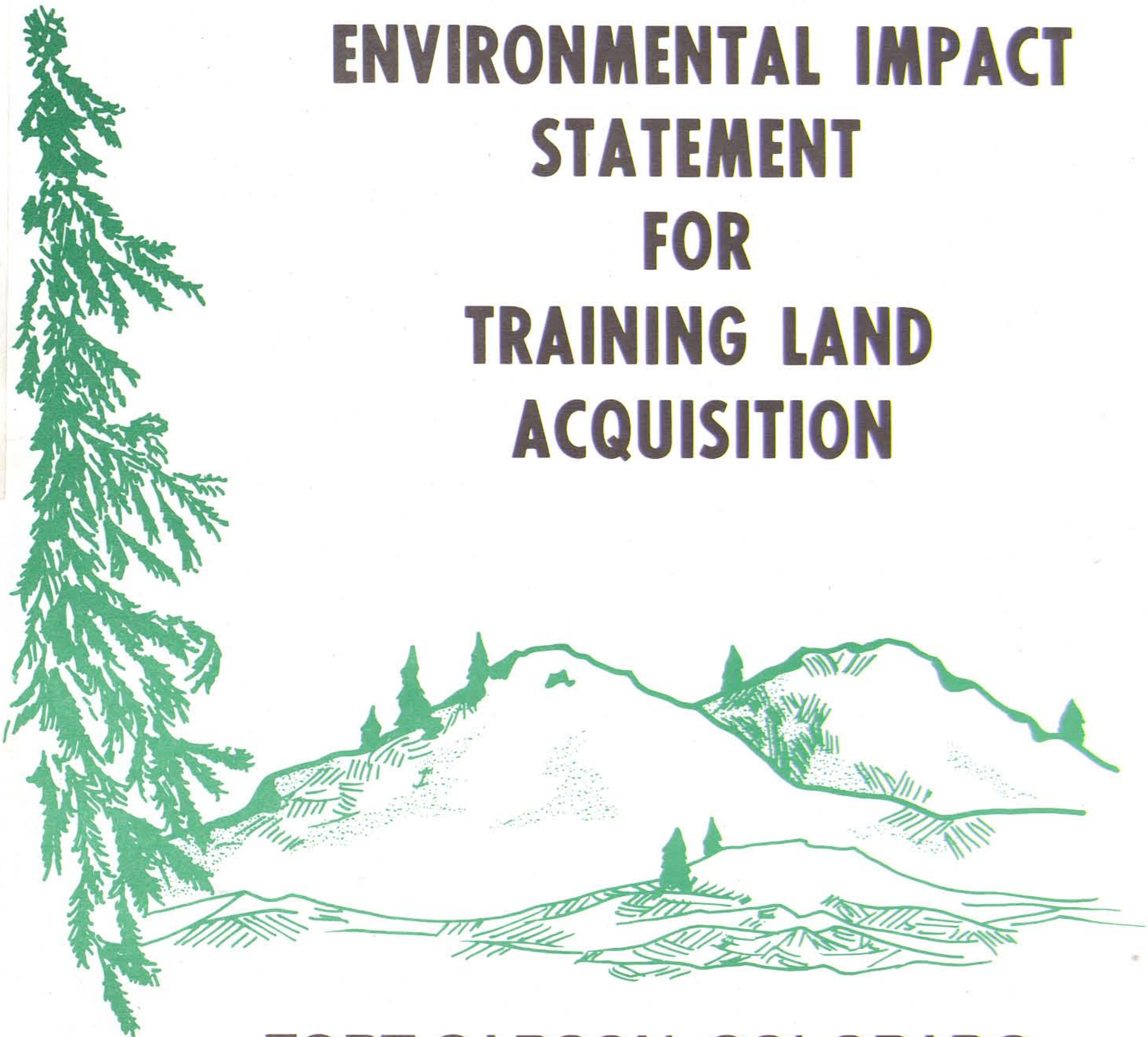
COLORADO

FINAL

ENVIRONMENTAL IMPACT STATEMENT FOR TRAINING LAND ACQUISITION



FORT CARSON, COLORADO

THE MOUNTAIN POST

PUBLIC LAW 97-99 [H.R. 3455]; December 23, 1981

MILITARY CONSTRUCTION AUTHORIZATION ACT, 1982

An Act to authorize certain construction at military installations for fiscal year 1982, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Military Construction Authorization Act, 1982".

Military Construction Authorization Act, 1982

TITLE I—ARMY

AUTHORIZED ARMY CONSTRUCTION PROJECTS

SEC. 101. The Secretary of the Army may establish or develop military installations and facilities by acquiring, constructing, converting, rehabilitating, or installing permanent or temporary public works, including land acquisition, site preparation, appurtenances, utilities, and equipment, for the following acquisition and construction:

INSIDE THE UNITED STATES

UNITED STATES ARMY FORCES COMMAND

Fort Bragg, North Carolina, $1,500,000.
Fort Campbell, Kentucky, $1,500,000.
authorizing Pinon Canyon
Fort Carson, Colorado, $29,890,000.
Fort Drum, New York, $14,480,000.
Fort Greely, Alaska, $1,150,000.
Fort Hood, Texas, $28,710,000.
Fort Irwin, California, $43,350,000.
Fort Lewis, Washington, $6,700,000.
Fort George G. Meade, Maryland, $3,350,000.
Fort Polk, Louisiana, $630,000.
Fort Riley, Kansas, $4,640,000.
Fort Stewart/Hunter Army Air Field, Georgia, $28,500,000.
Fort J. M. Wainwright, Alaska, $1,200,000.
Presidio of San Francisco, California, $520,000.

UNITED STATES ARMY TRAINING AND DOCTRINE COMMAND

Carlisle Barracks, Pennsylvania, $620,000.
Fort Belvoir, Virginia, $3,600,000.
Fort Benjamin Harrison, Indiana, $5,120,000.
Fort Benning, Georgia, $21,810,000.
Fort Bliss, Texas, $3,700,000.
Fort Dix, New Jersey, $28,040,000.
Fort Eustis, Virginia, $8,280,000.
Fort Knox, Kentucky, $620,000.
Fort Leavenworth, Kansas, $670,000.
Fort Lee, Virginia, $9,870,000.
Fort McClellan, Alabama, $4,780,000.

(a) for medical and dental care provided by such facility to members and former members of the uniformed services and their dependents who receive such care under chapter 55 of title 10, United States Code. The rates of reimbursement shall be negotiated and agreed upon by the Secretary of Defense, the Secretary of Health and Human Services, and the appropriate officials representing the facility concerned. The rates of reimbursement shall be based upon medical and dental care costs in the area in which the facility concerned is located. 10 USC 1071 et seq.

SPECIAL PROVISIONS RELATING TO THE EXPANSION OF FORT CARSON MILITARY INSTALLATION, COLORADO

SEC. 912. (a) Section 6(a) of the Act entitled "An Act to provide for certain payments to be made to local governments by the Secretary of the Interior based upon the amount of certain public lands within the boundaries of such locality", approved October 20, 1976 (90 Stat. 2665; 31 U.S.C. 1606), is amended—

(1) by striking out "or" at the end of clause (4);

(2) by adding "or" at the end of clause (5); and

(3) by adding at the end thereof the following new clause:

"(6) located in the vicinity of Purgatory River Canyon and Pinon Canyon, Colorado, and acquired after the date of the enactment of this clause by the United States for the purpose of expanding the Fort Carson military installation;".

(b) The Secretary of the Army shall adhere to all commitments made by the Secretary of the Army concerning environmental mitigation measures (including those regarding salinity) that are contained in the final environmental impact statement on the proposed Fort Carson military installation land acquisition.

LAND CONVEYANCE, CECIL COUNTY, MARYLAND

SEC. 913. (a) The Federal property constituting the former Naval Training Center, Bainbridge, Cecil County, Maryland, is hereby declared to be surplus property within the meaning of section 3(g) of the Federal Property and Administrative Services Act of 1949, and the Administrator of General Services is authorized to dispose of that property under such Act. Surplus property, disposal. 40 USC 472.

(b)(1) Proceeds from the disposition of property under this section shall be used by the Administrator to discharge any lien, encumbrance, contract claim, or other charge on or related to the property.

(2) The Secretary of the Navy, after consultation with the Administrator, shall determine the form and amount of any compromise or settlement of any claim against the United States with respect to the water agreement dated March 24, 1943, between the United States and the town of Port Deposit, Maryland.

(c) The exact acreages and legal descriptions of the property declared to be excess property by subsection (a) shall be determined by surveys that are satisfactory to the Secretary of the Navy.

LAND CONVEYANCE, LONG BEACH, CALIFORNIA

SEC. 914. (a) The Secretary of the Army (hereinafter in this section referred to as the "Secretary") is authorized to convey to the city of Long Beach, California (hereinafter in this section referred to as the "city"), all right, title, and interest of the United States in and to a tract of land of varying width consisting of 0.7176 acres and extending

DEPARTMENT OF THE ARMY
HEADQUARTERS, FORT CARSON AND 4TH INFANTRY DIVISION (MECHANIZED)

DRAFT ENVIRONMENTAL IMPACT STATEMENT

TRAINING LAND ACQUISITION FOR FORT CARSON, COLORADO

MICHAEL E. HALLA
Environmental Program Director
Fort Carson

Approved By:

LOUIS C. MENETREY
Major General, USA
Commanding

Approved for the FORSCOM Commander:

CHARLES P. GRAHAM
Major General, General Staff
Deputy Chief of Staff
Operations

Approved By:

JAMES C. SMITH
Major General, General Staff
Director of Training
Headquarters, Department of the Army

RESPONSIBLE AGENCY:

DEPARTMENT OF THE ARMY

TITLE OF PROPOSED ACTION:

DRAFT ENVIRONMENTAL IMPACT STATEMENT

ACQUISITION OF TRAINING LAND FOR FORT CARSON, COLORADO IN HUERFANO, LAS ANIMAS AND PUEBLO COUNTIES, COLORADO

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ABSTRACT:

The Department of the Army proposes to acquire one of two large parcels of land in southeastern Colorado to be used for combat maneuver training by the 4th Infantry Division (Mechanized), Fort Carson, Colorado. Three Land Use and Management Plans and their associated impacts are discussed for each site. The Increased Use Scenario is recommended for each site. The potential impacts are similar and both sites are reasonable and feasible alternatives.

DATE BY WHICH COMMENTS MUST BE RECEIVED: July 21, 1980

PUBLIC HEARINGS:

Hearings will be held from July 7-11, 1980, in the following Colorado cities: LaJunta, Trinidad, Walsenburg, Pueblo, and Colorado Springs. Locations and times will be announced.

Page 2-33, Figure 2-9	Change: Increased use scenario, year number 2 from BCE to BCD.
Page 2-39, Table 2-9	Add: For Unit Rotation F, add 0.0 to the Brigade and Division Training columns. The 5 refers to the footnote.
Page 2-40, paragraph 2.6.4., line 5	Change: 28,371 vehicle-days to 25,440 vehicle-days.
Page 2-43, Table 2-11, footnote 2, line 2	Change: three years to four years.
Page 2-44, Figure 2-11	Change: There would be no use of the soil and endangered plant protection areas under the Increased Protection scenario. See Figure 2-7, page 2-30 for the correct representation.

Reference	Correction or Explanation
Page 2-52, paragraph 2), line 5	Change: Reviewers should to reviewers may want to.
Page 3-15, Range Condition	Add: The range site percentages in this section do not all correspond with those shown at Table 3-3 because the table reflects mapping unit complexes as well as individual range sites.
Page 3-19, Endangered Plant Species	Add: Daplopappus fremontii sp monocephalus is a proposed endangered plant.
Page 3-28, Table 3-9	Change: 1 square mile - 259,093 hectares to 259 hectares.
Page 3-29, 2nd paragraph, line 5	Change: present cantonment area - to proposed cantonment area.
Page 4-29, 1st paragraph, line 5	Change: Table 4-9 to Table 4-8.
General	The use of certain verbs in this document, such as "will", are of no significance relative to the decision process. Any action described as something that "will" occur should be interpreted as something that "would" occur. At this time no decisions have been made.

ERRATA

The following corrections and explanations are considered noteworthy. They are included to reduce any confusion that the original text might create. This list is not intended to be all inclusive. Additional corrections and recommendations are welcome and will be considered in the final document.

Reference: To be inserted on page 4-24 after first 4 lines.

Add: Aquatic Ecology

Impacts. Impacts of the proposed military training and related activities are anticipated to be minimal to the existing aquatic ecosystems on the Huerfano River Parcel, which are limited in extent. These include seeps, pools and stock ponds. The aquatic ecosystems may show an increase in suspended solids as a result of increased sedimentation in streams and ponds and from dust from military activities settling on water surfaces. The increase in turbidity and salinity from soil erosion and runoff would reduce the primary production of the stream ecosystem and lessen the habitat potential for some fish species through lowered dissolved oxygen (DO) levels and higher total dissolved solids (TDS). The turbid and silty habitat is also undesirable for fish spawning, and abrasion and clogging of gills would also occur. The number of fish species tolerant to such conditions is very low. The wildlife protection area on the Huerfano River Canyon may cause the presently poor aquatic habitat to improve, even though the river is historically intermittent and turbid.

Water quality conditions could deteriorate due to accidental release of pollutants. In order to minimize eutrophication, fish kills, and an even more undesirable aquatic habitat, control procedures must be implemented, as discussed in U. S. Army Regulation No. 200-1 (Appendix E).

A possible beneficial impact after land acquisition is that livestock grazing would be curtailed on the parcel. Therefore, fecal coliform levels may decrease and the previously grazed vegetation, particularly the shrubs along the streams may show improved growth potential as a result of the absence of cattle.

Mitigation Measures. The Huerfano and St. Charles Rivers contribute dissolved salt concentrations to the Arkansas River, (U. S. Bureau of Land Management, no date). Adequate erosion, sediment and runoff control measures in the Huerfano River Parcel would limit the contribution of sediment to the Arkansas River from the parcel. Other stream crossings would be riprapped to limit potential erosion downstream (see Sections 4.1.4.1 and Appendix E). The Arkansas River is of importance because it is classified as a moderate to limited fishery resource area (Colorado Division of Wildlife, 1979). The maintenance of the springs, pools and stock ponds on the parcel would provide continued habitat for aquatic organisms. If water quality conditions improve, stocking of tolerant fish species may be possible.

The Army would undertake a comprehensive fisheries inventory of the limited perennial aquatic habitats on the parcel. This study would confirm the presence of any significant species. If the Arkansas River Darter is recorded, the Army would institute consultation with the Colorado Division of Wildlife to ensure protection of this species.

in July 1979 with the publication of a "Notice of Intent" in the Federal Register and the solicitation of public input by means of a letter distributed to individuals, citizen groups and governmental agencies. Additional input was obtained at four public meetings held in August. Originally, one meeting was scheduled for Walsenburg, but meetings in Trinidad, Pueblo and La Junta were added to respond to local interest.

The results of this scoping process indicated that individuals and agencies were generally concerned about the entire spectrum of environmental and social issues. Particular interest existed concerning the following potential impacts:

1. Degradation of vegetation and soil;
2. Economic changes to local economies;
3. The condemnation of privately owned land;
4. Degradation of air quality due to particulates;
5. Increased sound levels;
6. Degradation of water quality due to sedimentation;

The purpose for the acquisition of a satellite training facility is to provide maneuver area for battalion-size units of the 4th Infantry Division and Reserve Units. Such maneuvers are now conducted at Fort Carson, which consists of 137,291 acres. Of that total acreage, only 56,170 acres are available for maneuver training and only 22,000 of those acres are in one contiguous training area.

According to established standards, about 82,000 contiguous acres are required to accomplish the most land-intensive batallion maneuver training event. However, this requirement does not consider whether the land in question can support continual training year after year, without being rested. Land in semi-arid southeastern Colorado cannot accommodate such perpetual use, and land requirements were estimated to be about 200,000 acres to allow for rest and recovery of land on a rotating basis.

The training use that a satellite facility would receive was estimated based on the maximum annual training requirement. This maximum requirement represents ideal conditions of training funds availability and competing commitments of division assets. This maximum training load consists of each of the three brigades in the division traveling to the satellite facility twice year for a 30-day training period, about 20 days of which would involve maneuvers. In addition Reserve units would maneuver at the site for two-week periods during the months of June, July and August. This maximum training projection also included one division size training period every other year.

An austere cantonment facility would be constructed at either site for administrative purposes, but the emphasis would be on training and living in the field.

Live firing of weapons would not be conducted at the satellite facility. Blanks and artillery simulators would be used. Helicopter and high performance aircraft support would be provided at the site.

A number of alternatives to the acquisition of the Huerfano River or Pinon Canyon Parcels were considered, including numerous internal and external training management changes such as training seven days a week or relocating a portion of the units of the division. All of these actions, **were deleted from further consideration as not fulfilling the basic goal of providing the required training level.**

The only course of action that can reasonably meet the training goal is the acquisition of additional training land. Within this category, 22 potential sites were identified and analyzed for their capability to meet training requirements. Numerous other areas within a one-day travel distance of Fort Carson were not included in the final list of 22 because of unacceptable terrain characteristics. For instance, large areas northeast of Fort Carson as well as the Comanche

National Grasslands near the Pinon Canyon Parcel are sparsely populated, but they are flat and open prairie, providing no terrain relief or vegetative cover, both of which are critical to successful maneuver training. On the other hand, large areas of National Forest properties were discounted because of their extreme terrain relief which prohibits the safe passage of tracked vehicles.

Of the 22 potential sites, only the Huerfano River and Pinon Canyon Parcels are considered reasonable and feasible alternatives. A detailed Land Use and Management Plan (LUMP) was developed for each site to allow assessment of potential impacts. Three varying LUMP scenarios were devised for each parcel; Balanced Use/Protection, Increased Use and Increased Protection. Seven major variables were evaluated for these LUMPs:

Training Intensity
Time of Use - Rotation and Deferment
Boundary
Limited and Restricted Use Areas
Cantonment Location
Road Development
River Crossings

The first two, Training Intensity and Time of Use, are the key variables and are most indicative of potential impacts.

In addition to analysis of these variables, the LUMP incorporates numerous natural resource management measures that would be conducted at either site as part of their routine operation. A responsible land manager would perform the majority of these resource management measures, such as fence construction and implementation of conservation plans for seeding and erosion control. However, some of the measures exceed the average commitment, such as the graveling of all major roads and trails to minimize particulate emissions, the establishment of water, air, sound, vegetation, and wildlife monitoring networks, and plans for an experimental grazing program.

The potential impacts of implementing each scenario at each site were assessed. The difference in impacts between the Huerfano River and Pinon Canyon Parcels were not sufficiently significant for a clear choice at this time. Accordingly, both are still considered equally reasonable and feasible.

However, preliminary conclusions representing a specific proposal for the use and management of either property have been reached. These conclusions will allow reviewers to focus on the impacts associated with the LUMP scenarios. The Increased Use LUMP scenario is proposed for either site with some modification to provide additional vegetative protection. This scenario is proposed based on the level of training it provides. The key elements of the proposed plan are:

1) Training Intensity - The Huerfano River site would allow from 4.1 to 4.8 brigade training periods, depending on the specific training areas used during any given year. The Pinon Canyon site would allow from 4.4 to 4.7 brigade training periods. Training intensities for all scenarios were projected after establishing the carrying capacity of the parcel based on inherent range site stability characteristics and present vegetation conditions.

2) Time of Use - Rotation and Deferment - Each parcel was divided into five Management Units for purposes of training control and rotation. Under this scenario, three of the five units would be in use during any given year. After three years of use, each Management Unit would be rested for two full years. The only activities that would be allowed on a unit being rested are land enhancement measures, experimental grazing, hunting, baseline natural resource studies, or tours by interested individuals or groups.

In addition to complete rest under the rotation plan, Management Units would not be used from 15 December - 15 January and from 1 April - 30 June. This scheduled deferment program includes the month of June, not originally included in the Increased Use scenario, because it is particularly beneficial to grasses.

Finally, training would be deferred on an unscheduled basis whenever excessively wet soil conditions occur to prevent abnormally severe damage to soil and vegetation.

3) Boundary - The preferred boundary is that shown on Figures 2-4 and 2-8, with the notable exception of the Purgatoire River Canyon and the "tail" of the Huerfano River Canyon. These areas are not included because they are not required for training, nor do they contribute notably to the integrity of the training area.

A sixth Management Unit (F), was considered as part of the Increased Use Scenario for the Pinon Canyon Parcel. It is not included in the preferred boundary because of the disadvantages associated with its location across the Purgatoire River from the rest of the parcel. However, if any major changes are required in the preferred boundary as the decision process proceeds, acquisition of Unit F may be reconsidered.

4) Limited and Restricted Use Areas - Several soil protection areas would be established at either site. These areas would coincidentally afford protection to an endangered plant species which could potentially occur.

The portion of the Huerfano and Cucharas Rivers within the main body of the Huerfano River Parcel would be established as a wildlife protection area and would also be considered for nomination as a State Natural Area. If the "tail" of the Huerfano River Canyon is obtained because of land acquisition procedures, the Department of the Army will recommend that it be similarly managed.

If any portion of the Purgatoire River Canyon is obtained by the government because of land acquisition procedures, and is retained, the Department of the Army will recommend that it be managed as a natural area.

5) Cantonment Area - The proposed cantonment area for the Huerfano River Parcel is near the Cedarwood access road; the proposed cantonment area for the Pinon Canyon site is near Thatcher. Both cantonment sites were selected primarily for their proximity to road and railroad facilities. When a brigade moves down to a satellite area, the wheeled vehicles would be convoyed by road and tracked vehicles would be shipped by rail.

6) Road Development - Development of roads for either site would emphasize upgrading and use of existing roads with additional construction to facilitate easy access to all Management Units.

7) River Crossings - A bridge is proposed to cross the Huerfano River east of the cantonment area. The bridge would provide more direct access to Management Units east of the river and would not become a focal point for maneuvers. Crossing of the Huerfano River would occur downstream of the wildlife protection area and on all other drainages, except the St. Charles River, as required. Repetetive use areas would be riprapped or stabilized.

At the Pinon Canyon Parcel, the Purgatoire River would not be crossed, side canyons would be crossed or traversed as required and repetitive use areas would be riprapped or stabilized.

The objective of the land use and management planning documented in this DEIS was to provide the most feasible balance between resource utilization for military training and long-term resource conservation. The recommended Increased Use Scenario represents the greatest use within the planning spectrum. However, because of the resource management measures incorporated into the scenario, to include the use of only three-fifths of the site for less than one-half of each year, the impacts of the proposal are considered reasonable when balanced against the training benfits.

The resources that would be affected at either site are basically quite similar with respect to environmental attributes such as soils, vegetation, wildlife, hydrology, sound and air quality. The following impacts would be expected if the Increased Use Scenario is implemented:

GEOLOGY AND MINERALS

Acquisition and use of the Huerfano River Parcel could affect the development of limestone resources in the extreme northwest portion of the parcel. The potential value of the deposits is presently an unresolved issue. However, the State Board of Land Commissioners has expressed an interest in allowing the limestone development. Mitigation of this potential conflict could be accompanied by not acquiring the four sections involved. That exclusion would affect the training value of Management Unit A, and therefore for purposes of this document the issue will remain unresolved. If the estimated value of the limestone deposits can be obtained and verified during the review of the DEIS, a resolution will be identified in the final EIS.

Soils - The Huerfano River Parcel would experience more soil loss due to wind erosion than the Pinon Canyon Parcel. However, overall impacts to soil and soil loss would be more significant at the Pinon Canyon site.

Vegetation - Impacts on both parcels would be basically the same. Range site stability of the Huerfano River Parcel is 28 percent greater than the Pinon Canyon Parcel but that factor was taken into consideration in establishing training intensity.

Hydrology - Potential water quality impacts due to sedimentation and salinity are more significant at the Pinon Canyon Parcel than at Huerfano River Parcel. More direct training activity would occur within the Huerfano River Parcel because of its location in the central portion of the parcel.

Potential impacts to ground water could be moderate to severe depending on the source of potable water supplies. At this time, the provision of potable water at either site is an unresolved issue. It appears to be a bigger problem at the Huerfano Parcel because the most productive sources are located on the east side of the parcel and the preferred cantonment area is on the west side. A possible source of water closer to the cantonment would be the Huerfano River alluvium.

Two possible sources of potable water have been identified at the Pinon Canyon Parcel, municipal supplies from Trinidad provided by pipeline or, more preferably, development of locally known supplies, by private individuals for purchase on site.

WILDLIFE

Wildlife habits and populations are very similar. The Pinon Canyon Parcel has one additional species, the Turkey, and could be utilized by the State for Bighorn Sheep and Peregrine Falcon Plants.

AQUATIC ECOLOGY

The Huerfano River Parcel has a higher potential for being affected than the Pinon Canyon Parcel. However, the effects at either site would be negligible.

AIR QUALITY

The potential impact on actual pollution levels at either site is virtually identical. However, because of the proximity of the Huerfano River Parcel to the Pueblo particulate non-attainment area, the particulates generated have a greater potential impact at that site.

SOUND

The overall potential noise impact would be less for the Pinon Canyon Parcel than the Huerfano River Parcel because there are fewer persons to be affected. The sound levels would be virtually the same.

SOCIOECONOMICS

Potential impacts to persons presently residing at either site would be about the same since both support about the same number of people. Although slightly more cattle would be displaced at the Huerfano River Parcel, the local impact would be more significant at the Pinon Canyon Parcel because of the predominantly agricultural economic base as opposed to the industrial base in Pueblo. Potential impacts from the loss of annual tax revenue is also more serious at the Pinon Canyon Parcel. Transportation impacts are potentially more significant at the Pinon site because of additional fuel consumption.

The potential impacts to cultural resources are negligible for both sites since the required surveys and mitigation would be accomplished before any training use.

Acquisition of the Pinon Canyon Parcel would have a potentially severe impact to a portion of an area being studied for possible designation as a National Natural Landmark under the administration of the Department of the Interior. The area near the Purgatoire Canyon is considered to be significant for its canyon geology which is unique in the eastern plains of Colorado. The potential impact would be from off-road vehicle activity within the area and its effect upon the aesthetics of the area as well as increased erosion. The exact significance is difficult to ascertain because the proposed boundary of the area being considered has been modified or described several times and may be subject to further change. The most spectacular portion of the area and almost all of the red rocks is outside the area that would be acquired.

In conclusion, both the Huerfano River and Pinon Canyon Parcels are reasonable and feasible alternatives for resolving the shortfall of maneuver training land for the 4th Infantry Division at Fort Carson, Colorado. The land use and management planning resulted in the preliminary conclusion that the Increased Use Scenario should be proposed because of its level of training and associated impacts.

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FIGURES

FIGURES (Continued)

FIGURES (Concluded)

1.0 THE PURPOSE OF AND NEED FOR THE ACTION

1.1 INTRODUCTION

The purpose of this Draft Environmental Impact Statement (DEIS) is to examine the proposed acquisition of land near Fort Carson, Colorado, by the Department of the Army (DA) for military training purposes. Two parcels of non-contiguous land in southeastern Colorado are proposed as reasonable and potentially feasible alternatives to satisfy the shortfall of maneuver training land at Fort Carson. The DEIS presents descriptions of the affected environment and projected environmental consequences should either of the subject land parcels be acquired as a satellite training area for the 4th Infantry Division (Mechanized).

The DEIS is prepared according to the requirements of the National Environmental Policy Act (NEPA), the Council on Environmental Quality Regulations on implementing NEPA (40 CFR 1500-1508) and Department of the Army Regulation AR-200-2, Environmental Considerations in the Department of the Army (Federal Register, V. 45, No. 3, January 4, 1980, p. 1086).

The DEIS constitutes phase three of the Fort Carson, Colorado land acquisition process. Phase one was completed with the publication of Army Training Circular 25-1, Training Land (TC 25-1), in August 1978. This circular provided a uniform method for calculating training land requirements. Using this method, Fort Carson prepared a Land Use and Requirements Study (LURS) (Phase two) which was approved by the Secretary of the Army in December 1978. This study concluded that Fort Carson had a significant maneuver land shortfall. Phase three was initiated with the preparation of a preliminary Analysis of Alternatives Study (AAS), which analyzed and evaluated options for Fort Carson to satisfy the previously identified shortfall of maneuver land. The preliminary AAS indicated that only the acquisition of a non-contiguous but nearby training site could reasonably solve the shortfall. It further indicated that two land parcels, the Huerfano River and Pinon Canyon parcels, both in southeastern Colorado, were reasonable and feasible sites. In June 1979, Fort Carson commenced this portion of the third phase of the process which involves preparation of the DEIS. The AAS and the DEIS will be finalized concurrently.

1.2 PURPOSE

The purpose of this action is to acquire about 200,000 acres (80,940 hectares) of land for Fort Carson, Colorado in order to meet the minimum maneuver training space needs for battalions of the 4th Infantry Division (Mechanized) and, at the same time, protect existing land resources.

1.3 NEED

1.3.1 General

The Fort Carson Land Use and Requirements Study (LURS) analyzed the use of, and the need for, land to accomplish the training mission of the 4th Infantry Division (Mechanized) at Fort Carson. This mission includes providing active Army and Reserve Component (RC) units with training areas which permit them to attain and maintain an effective combat readiness posture. The overall problem of providing and maintaining sizable land areas for military training activities is inherently complex and sophisticated, and any solution must balance national defense land use needs and land management/environmental protection requirements.

Since its initial establishment in January 1942, Fort Carson has stationed and trained major Army units in three wars. It was expanded in 1965 from its original 60,000 acres (24,282 hectares) to its present size of 137,391 acres (55,602 hectares). This expansion was necessitated by an increase in the number and type of forces stationed at the post. Fort Carson is now the home of the 4th Infantry Division (Mechanized), which includes twelve highly mobile mechanized infantry and armor battalions. The trend toward mechanization during the past two decades has become increasingly important with greater emphasis on training for a flash war in Europe and contingencies in the Middle East and Mediterranean region.

The rapidly changing technologies of warfare require increased maneuver training areas to keep pace with the modern battlefield and new training strategy. The need for greater mobility and dispersion is a result of advances in radio and electronic communications technology, significant increases in the effective range and lethality of weapons, and adjustments in tactical deployment training concepts. Military aviation developments have also influenced this growth in battlefield size with the advent of jet aircraft powered with high performance engines and recent innovations in helicopter warfare. Technological developments which bring pressure for change include the electronic computer, micro-miniaturization of electronic circuits, the LASER, advanced radar and infrared devices, missile applications down to the rifleman level, and significantly, the proliferation of nuclear weapons among nations.

The effect of changing technology is demonstrated by an action which was implemented at Fort Carson in late 1975 and early 1976, when a new tank gunnery training round, the armor piercing, discarding, sabot target practice (APDS-TP-T) round was introduced. This round has a much higher muzzle velocity and considerably greater range and accuracy than previous ammunition. The greater range, however, also created the need for much larger range safety fans. Because of this need, the safety fans at Fort Carson were extended approximately 4,000 meters, which, in turn, removed 4,700 acres (1,902 hectares) of maneuver training area and added them to the restricted area.

In 1975, a major revision in overall training programs was instituted. The establishment of a major training organization, the U.S. Army Training and Doctrine Command (TRADOC) preceded a complete reevaluation of the entire scope of training activities. The former Army Training Program (ATP) emphasizing structured training activities was replaced with the Army Training and Evaluation Program (ARTEP) stressing results instead of structure with emphasis on decentralized activities and leadership responsibilities. The expanded size of the battlefield was translated into larger training areas as required by the ARTEP concept.

The ability of the division's combat units to reach and sustain an optimum level of readiness is directly related to the available training. The quality of training is influenced by the maneuver constraints imposed by the available training area. Because of changes in methods of warfare, parcels of land that once were ample for training entire divisions are scarcely adequate today for brigade training exercises and, in some cases, battalions.

The effectiveness of training at battalion level is critical to battle success, because the battalion is the lowest level at which all elements of the combat team can be assembled. In combat, the battalion is the focal point of the conflict. The battalion commander formulates the plan of action, deploys his unit about the battle area and fights the battle. He must communicate over vast distances to his maneuver and supporting elements, deploying them to meet the enemy's main thrust. In peacetime, the battalion is also the focus of training management and the element from which lower echelons draw their support.

Realistic combat situations must be simulated for training units, requiring training areas that accommodate deployment over land areas comparable to those expected in actual combat.

In addition to specific training need, the maintenance of the land resource at Fort Carson is a consideration. At present levels of training, the soils and vegetation resources are used beyond their capacity to support training. Such overuse may result in irreversible damage to Fort Carson land areas. Training requirements and environmental protection should be balanced to allow achievement of both goals.

1.3.2 Land Use and Requirements Study (LURS)

The purpose of the LURS was to quantify and compare the present range and maneuver area at Fort Carson against the baseline requirements compiled in Training Circular 25-1, thereby identifying and quantifying any range and/or maneuver area shortfall. The LURS was based on the following assumptions:

(1) Fort Carson would continue to provide all training support for divisional and non-divisional units stationed at Fort Carson and support for U.S. Army Reserve, National Guard, Reserve Officers Training Corps and other sister reserve units within its capabilities;

(2) Current Fort Carson unit stationing would remain basically unchanged except for already announced changes;

(3) All Army units, to include combat support, combat service support and Reserve Components, would be trained under the ARTEP concept;

(4) All weapons firing and gunnery training would continue to be conducted at Fort Carson;

(5) Battalion and lower level ARTEP unit training would be conducted at Fort Carson;

(6) Fort Carson would be allocated the operating funds (P2 Mission Funds) to sustain annual training requirements at or above the present level; and

(7) Land management practices currently in effect at Fort Carson would continue to limit the use of specific areas periodically for environmental purposes.

Baseline training requirements were identified and current usage data was developed for both maneuver areas and ranges. As shown on Table 1-1, Fort Carson has an average daily availability of about 56,170 acres (23,732 hectares) of maneuver training land. However, the largest contiguous training area is 22,000 acres (8,903 hectares), which is 60,531 acres (24,297 hectares) fewer than the area needed for the largest ARTEP event, the opposed Delay.

Utilizing the Army Training Land Analysis Model (ATLAM) as specified in TC 25-1, maneuver training area shortfall was identified. The model is based upon the fundamental requirement for areas of adequate size, configuration and contiguity to allow each battalion combat force to train and conduct formal evaluations under the ARTEP concept. The impact of terrain, maneuver scenarios and schedules on acreage required was analyzed within the model. Internal management actions were addressed, and analysis of other internal actions that could affect an identified shortfall was accomplished.

The Fort Carson LURS was approved by the Secretary of the Army on 19 December 1978. The conclusions of the LURS are as follows:

1) Baseline land requirements exceed present capacity.

2) Vegetation condition for the majority of Fort Carson land is rated as poor to fair. The condition will continue to decline unless present levels of use decrease.

3) About twenty percent of the maneuver area contains steep terrain which limits use by mechanized units.

4) Numerous training areas are isolated due to nearby terrain, environmental damage and off-limits areas.

5) Returning environmentally restricted land to maneuver use, relocating impact areas, or reducing impact area size do not provide contiguous maneuver terrain of the necessary quality or quantity.

6) Fort Carson has adequate range facilities and impact areas.

7) Based on the ATLAM, Fort Carson has a minimum shortfall of 54,331 acres (21,988 hectares) of contiguous maneuver training area.

8) Based on environmental management requirements, Fort Carson has a minimum shortfall of 150,000 to 200,000 acres (60,705 to 80,940 hectares) of suitable maneuver training land; and

9) Current trends in material development and training indicate an increasing demand for additional training area for Fort Carson.

TABLE 1-1

LAND USE AT FORT CARSON

AREA	NON-MANEUVER ACRES (Hectares)	ACRES (Hectares)
Fort Carson Total		137,400 (55,606)
Cantonment, Impact, Ammunition Storage, Tank Ranges	39,270 (15,893)	
Topographically Unsuitable	13,820 (5,593)	
Set Aside for Environmental Protection	18,540 (7,503)	
Range Safety Fans	9,600 (3,885)	
Total Off-Limits		81,240 (32,874)
Available Maneuver Land		56,170 (22,732)

1.4 USE OF SITE FOR TRAINING

1.4.1 Concept

Training would normally be conducted by battalions. To exercise the command and control structure, three to four battalions plus their attendant support elements would travel to and use the training area at any one time under the control of brigade headquarters. Therefore, although the basic unit to be trained and tested is the battalion, data noted below are expressed in terms of brigade totals. The maximum yearly training requirement for a remote site would be six Active Duty brigade training periods and three Reserve training periods. In order for this amount of training to be accomplished, all critical factors such as available training funds and competing commitments of division assets would have to be ideal. Each Active Duty brigade training period would consist of 10 administrative days and 19-21 maneuver days, for a total of 6 months (Table 1-2). The Reserve training period would extend over three months and would consist of a series of training sessions of 2 administrative days and 10 maneuver days.

TABLE 1-2

MAXIMUM ANNUAL TRAINING REQUIREMENTS FOR ACTIVE AND RESERVE FORCES

	Probable Training Periods/ Year	Maneuver Days/ Training Period	Total Vehicles/ Training Period[a]	Total Vehicle Days/ Training Period
		Wheeled		
Brigade[b]	6	20	826	16,520
Division[c]	.5	20	2,478	49,560
Reserves	3	10	750	22,500
		Tracked		
Brigade	6	20	432	8,640
Division	.5	20	1,296	25,920
Reserves	3	10	370	11,100

[a]Only a total of 507 wheeled and tracked vehicles would be maneuvering at one time.

[b]The listing of brigades does not mean brigade maneuvers would be conducted. Battalion maneuvers would be conducted. However, all the battalions and supporting units of a brigade would normally travel together to the site. Training in command, control and communications would thus be provided.

[c]The Division exercises would occur once every two years.

1.4.2 Personnel and Vehicles

A maximum of 5,085 personnel would use the training area per brigade training period. About 826 wheeled and 432 tracked vehicles would be located within the training area per brigade training period. Of these, about 605 wheeled vehicles and 366 tracked vehicles would be used for maneuvers, as shown in Table 1-3. The total of 971 available maneuver vehicles would be divided among four line battalions (armor and infantry) and one artillery battalion. Average maneuver levels would include two battalions plus their artillery support, for a total of 507 wheeled and tracked vehicles maneuvering at one time. A detailed list of vehicle type and attendant training intensity is given in Appendix A. It should be noted that these projected vehicle levels are conservative so that the worst case situation is depicted.

TABLE 1-3

VEHICLES PER BRIGADE

Category of Vehicles	Wheeled		Tracked	
Total Vehicles		826		432
Stationed in Cantonment	154		25	
Inoperable/Mechanical Difficulties	67		41	
Vehicles Available for Maneuver		605		366

Army aviation operations are anticipated to total 774 hours of helicopter use per brigade training period. Helicopters would fly at least 1,000 feet (305 m) above ground level upon approach to the training area. Upon entering the area perimeter, they would routinely fly at heights of 200 feet (61 m) above ground level. Helicopters would not fly below the rim of major canyons.

U.S. Air Force tactical support over the training area would be provided primarily from Buckley Air Force Base, Denver, Colorado. Over a one year training period, it is estimated that roughly 100 missions would be flown with an average of two aircraft per mission. During a mission three to five tactical passes would be accomplished over a 35 minute period. For certain training periods, missions may be required on 10 to 12 days, while other training periods may not require any air support. On a single day, the greatest number of missions expected is 6 to 7 over a 12 hour period from dawn to dusk. A night mission may occur once during the 20 day training period. A single F-111 would probably be utilized for this exercise. Jet flight altitudes would be as follows:

- En route to training area - 10,000 to 24,000 feet above ground level (AGL).

- Within 5 miles of the training area - 1,000 to 5,000 feet AGL.

- Within the training area - 200 to 1,000 feet AGL.

1.4.3 Cantonment and Bivouac Sites

A cantonment area with permanent facilities would be established within an area of about 150 acres (61 hectares). However, except for some command headquarters and other support personnel, a large portion of the brigade would be in the field during an exercise. Field activities would be supported by strategically placed bivouac sites. It is estimated that 2 acres (0.8 hectares) would be required for each battalion field bivouac site, and that 6 acres (2.4 hectares) would be required for each brigade field bivouac site. Details on cantonment and bivouac facilities are provided in Appendix A.

1.4.4 Live Firing

No live firing would be conducted in the parcel. Blank ammunition, simulators, and non-persistent training gas, such as tear gas, would be used.

1.4.5 Representative Training Exercise

Although a multitude of exercise scenarios would be used to train the battalions, some generalizations apply. Commonly, two battalions and supporting artillery (a total of about 507 tracked and wheeled vehicles) would exercise within the training area. One battalion would occupy a friendly or defensive position, generally controlling an identifiable portion of the landscape. The other battalion would be considered unfriendly or aggressive and would try to gain control of the landscape position(s) occupied by friendly forces. A third battalion would be in the field but would not normally be actively maneuvering.

The landscape of the training area would shape the possible exercises performed because in most exercises, battalions attempt to control the dominating terrain features of the unit. Terrain features can be deemphasized in the different training excercises to prevent repeat usage of the same butte, hill or river crossing; however, the training area designated for use in a given year would have a limited number of "dominant terrain features". Over time, therefore, all of these features would be used as military objectives.

In the early part of a 20-day exercise, opposing sides would send out small front-running companies to contact the enemy and define his position. Movement across the land would be random and isolated.

After the enemy's position is identified and terrain objectives defined, the major battalion forces would be deployed. During an exercise, travel would seldom be in large convoys or groups. As the terrain objective is defined, military actions would be concentrated toward this objective.

Most of the land within the training area would therefore be affected randomly and occasionally. Repeated passes would occur predominantly near the terrain objectives and nearby secondary positions. Most of these objectives would be high spots such as hills, ridges and buttes, areas of heavy concealment, or topographic "passage" areas. The open plains would be used mostly to reach areas of concealment and terrain objectives.

2.0 ALTERNATIVES

2.1 ALTERNATIVES ELIMINATED FROM DETAILED STUDY

2.1.1 Internal Training Management Changes

The following Internal Alternatives were analyzed in the Fort Carson Land Use and Requirements Study and were determined to be infeasible. The alternatives and rationale for eliminating them are as follows.

Incorporate 7-Day Training Week

Use of Fort Carson maneuver areas on a continuous 7-day basis was considered. For most training programs, continuous use is already occurring. Further action would be detrimental to troop morale during peacetime if maintained on a scheduled, continuous basis. It would also conflict with Reserve and National Guard units, which use available maneuver areas on a 7-day basis. The incorporation of a 7-day week would not increase the amount of contiguous maneuver area available. Thus, this alternative is not a reasonable or feasible alternative.

Alteration of Environmental Management Program

If areas currently restricted from use on Fort Carson for environmental management are made available for maneuver, serious soil and vegetation stability problems and consequent damage would result. The condition of vegetation and soil for the majority of Fort Carson is classified as fair to poor. Continual heavy use of areas now restricted would create serious soil stability problems. Most importantly, the addition of acreage set aside for environmental management would not satisfy the training land shortfall. Therefore, alteration of the Fort Carson Environmental Management Program is not a reasonable or feasible alternative.

Relocate or Alter the Impact Areas and Tank Firing Ranges

If current impact areas and/or tank ranges are rearranged to create additional maneuver area, increased noise and dust problems for the civilian population would result. Relocation would be expensive; training would be less than optimum because the most effective range placement would no longer be used. The training area could be increased by 20,690 acres (8,373 hectares), but the terrain is poor quality and would not satisfy the contiguous training area shortfall. Therefore, relocation or alteration of current impact areas and/or tank firing ranges is not a reasonable or feasible alternative.

Conduct Large Caliber Firing at Other Locations

Personnel and weapons could periodically move to other locations for live firing, thus reducing the size of current impact areas and/or range safety fans at Fort Carson. The resulting reduction in impact areas and/or range safety fans would be marginal, training costs would be significantly increased and training for Fort Carson and Reserve Units would be less effective. Most importantly, the 6000 acres (2429 hectares) of poor quality land gained would not satisfy the contiguous land shortfall. Therefore, conducting large caliber firing at other locations is not a reasonable or feasible alternative.

2.1.2 External Training Management Changes

Use of Maneuver Permits

Maneuver permits for use of nearby areas could be obtained from public or private sources. This alternative would be expensive and severely restrictive, with probable restrictions on off-trail maneuvers. Adjacent private land is not well suited or available in large enough parcels, and restrictions on public lands do not allow enough acreage to satisfy the contiguous maneuver area shortfall. The use of maneuver permits is not a reasonable or feasible alternative.

Relocate Units to Other Posts

A portion of the 4th Infantry Division (Mechanized) combat units could be permanently transferred to other installations in order to reduce overall demand for training/maneuver areas. The social/economic impact on the Pikes Peak region would be substantial, and the existing real property and service facilities at Fort Carson would be underutilized. Command and control of the separate units would be complicated and the combat capability of the division would decrease. Most importantly, relocation of troops would not change the non-contiguous, non-trafficable or environmentally restricted areas contributing to the contiguous maneuver area shortfall. Therefore, the acreage required to train battalions would still not be available, and relocating units to other posts is not a reasonable or feasible alternative.

2.2 NO ACTION

This alternative would maintain the current acreage and training activity at Fort Carson. The largest contiguous maneuver area, 22,000 acres (8903 hectares), is the primary area used by all battalions for ARTEP training and evaluation. This area is not large enough to accommodate the required ARTEPs. The current situation results in a shortage of available contiguous maneuver area, this is therefore not a feasible course of action for eliminating that shortage.

Two primary areas of impact are associated with this alternative: a continuing and accelerated loss of soil and vegetation and a further reduction in combat readiness as training values decline on Fort Carson.

The overall vegetative condition of Fort Carson is fair to poor, and the decline in vegetation and soil condition is self-perpetuating. As the fragile training areas reach a critical stage and their use is reduced or eliminated to avoid irreparable damage, military training is concentrated into the remaining training areas. Eventually, all the terrain would become overused and might suffer irreversible impacts. The training value of the installation also would continue to decline as less maneuver area is available for use. The situation could eventually become critical and the goals of training and resource management would become mutually exclusive. At that point, either the Fort Carson training area would become a sacrifice area or the training mission would be reduced or changed.

Impacts to other environmental attributes such as air, water, and sound are not considered significant under the No Action alternative, because current conditions would continue. Even though current activities result in some moderate to severe negative impacts in these environmental areas, implementation of the feasible alternative proposed in this document would not eliminate those impacts.

Finally, if the No Action alternative is selected, all positive and negative impacts associated with the acquisition of additional training land would not occur.

2.3 ALTERNATIVES CONSIDERED FEASIBLE - ACQUISITION OF ADDITIONAL TRAINING LAND

2.3.1 Criteria

The following criteria were used to determine if a potential land parcel was reasonable and feasible for satisfying the Fort Carson maneuver land shortfall.

1) Size: Minimum of 150,000 acres (60,705 hectares) to 200,000 acres (80,940 hectares);

2) Configuration: The site must allow for a maneuver block of 12 km x 29 km to support the largest ARTEP event, the mechanized infantry battalion in the delay;

3) Access: Year-around access from Fort Carson;

4) Topography: Suitable for maneuver by tracked vehicles;

5) Vegetation: Sufficient vegetative cover to retard soil erosion;

6) Remoteness: Far enough away from population centers to reduce local civilian inconvenience;

7) Distance and Travel Time: Within a 1-day motor march from Fort Carson;

8) Proximity to Roads: Near improved roads for good access and reduced development cost; and

9) Proximity to Railroads: Near enough to a railroad to establish a rail head.

2.3.2 Parcels Not Meeting Criteria

Adjacent Land Alternatives

Acquisition of adjacent land was presented as the primary alternative in a land acquisition proposal made by Fort Carson in 1974 (Figure J-1 in Appendix J). Based on the information and guidance available at the time, it was felt that the acquisition of three adjacent parcels would satisfy Fort Carson's maneuver land needs. However, the proposal to acquire adjacent parcels was rejected by Congressional Committee due to extremely high acquisition costs. The publication of Training Circular 25-1 and the Land Use and Requirements Study (1976) determined an increased need for contiguous maneuver training area; these documents made obsolete Fort Carson's previous estimate of the capability of adjacent parcels to satisfy its maneuver land shortfall. A new analysis of this alternative is therefore necessary.

Development costs for adjacent parcels would be minimal. Construction of additional buildings or utilities would not be required to support anticipated training use. Troop and support units could use existing post facilities to support all training activities. The only development costs would be for additional fencing and environmental management requirements.

Transportation costs would be minimal. The only increased cost would be associated with the increased distances troop units must move to and from the expanded training area. Operating costs would be minimal in comparison to costs associated with a non-contiguous location. Expanding the reservation boundaries would not require additional permanent party personnel and facilities on site. Security, maintenance and control of the adjacent parcels could be incorporated into the present post support plan. Total maintenance costs associated with environmental management would increase.

The greatest advantage associated with acquisition of the adjacent parcels is protection against further encroachment on Fort Carson. As the Colorado Springs area continues its economic growth, the area along I-25, to the east of the reservation between Colorado Springs and Pueblo, will be developed. The acquisition of the adjacent parcels would protect against further encroachment and reduce the possibility of future land conflicts.

The cost of the contiguous areas is a disadvantage. In 1974, the Omaha District Corps of Engineers estimated average cost per acre was $859.00. This is about an 8 to 1 cost ratio when compared with other acquisition alternatives and does not reflect increases in land value during the past five years.

The three parcels are flat or gently sloping open prairies scored by numerous dry stream beds and deep ravines. Several low ridge formations occur in the northeastern and southwest extremities. Vegetation and natural cover are lacking in the flat areas; sparse vegetation occurs along the stream beds and ravines. Land within the adjacent parcels is similar to and environmentally comparable with the contiguous land on the reservation. General environmental assessment of the adjacent parcels is fair to poor.

The acreage contained in the three adjacent parcels totals about 74,000 acres (29,947 hectares). Although all three parcels are contiguous to the reservation boundaries, two of the three are not contiguous to each other. The addition of these parcels to the reservation, due to untrafficable terrain, tank ranges, and configuration of impact areas, will not provide the required contiguous maneuver area. Therefore, acquisition of land adjacent to the reservation will not satisfy the shortfall of contiguous maneuver area and is not a reasonable or feasible alternative.

Non-contiguous but Nearby Site Alternatives

In 1976, three large non-contiguous training sites were offered for sale to the Army by private land owners. These were the Bolten Ranch in south central Wyoming, and the Huerfano River and Pinon Canyon parcels, both located in southern Colorado. Fort Carson included these sites in a systematic search program for suitable non-contiguous sites.

Fort Carson contracted with the environmental consulting firm of Dames & Moore of Denver, Colorado to identify and evaluate potential non-contiguous sites that could be used by Fort Carson to resolve the land shortfall. Using the criteria listed in Section 2.3.1, each site was given an overall rating. In addition, environmental assessments for the three offered parcels were prepared (Dames & Moore, 1978b, 1978c, 1978d).

Twenty of the 22 sites analyzed were rejected, primarily due to poor size, access, distance from Fort Carson, or configuration (U.S. Army Draft Analysis of Alternatives Study, no date). Table 2-1 lists the sites and the reasons for the conclusion that 20 of them are not reasonable or feasible alternatives. Locations of the rejected sites are shown on Figures J-1 through J-8 in Appendix J.

TABLE 2-1

EVALUATION OF ALTERNATIVE SITE

SITE DESIGNATION	SITE LOCATION	Large Size 1	Config-uration 2	Good Year-round Access from Fort Carson 3	Varying Topography yet Suit-able for Maneuvers by Track Vehicles 4	Good Vegetation Cover 5	Remoteness from Population Centers 6	Distance & Travel Time 7	Proximity to Roads 8	Proximity to Railroads (Adj) 9	Overall Rating
A	Las Animas County; West of Trinidad	A	A	U	U	U	A	A	A	A	U
B	Colfax County; New Mexico, West of Raton	A	A	U	U	U	A	A	A	A	U
C	Fremont County, Colorado	A	U	A	U	U	U	A	A	A	U
D	Costilla County, Colorado	U	U	U	U	A	U	A	A	A	U
[illegible]	[illegible] County, Colorado	A	U	U	U	A	U	A	A	U	U
[illegible]	Taos County, New Mexico	U	U	U	U	U	A	A	A	U	U
[illegible]	[illegible] County, Colorado	[illegible]	[illegible]	U	U	A	A	A	A	U	U
[illegible]	San Isabel National Forest, Gardner [illegible]	U	A	A	A	A	U	A	A	U	U
[illegible]	[illegible]	A	U	U	U	A	A	A	A	A	U
[illegible]	[illegible] County, Colorado	U	U	U	U	U	[illegible]	A	A	U	U
[illegible]	[illegible] Forest, [illegible]	U	U	U	U	A	U	A	A	U	U

Bolten Ranch Parcel

The Bolten Ranch Parcel, which wa [illegible] contains sufficient acreage to meet the [illegible] LURS. Location of the Bolten Ranch [illegible] (Appendix J). The environmental assessment [illegible] that military training objectives could [illegible] the parcel. The land configuration meets [illegible] ments, and a railroad and improved highways serve the area. [illegible] vantages are:

1) Distance of more than one day's travel time from Fort Carson;

2) The travel route through Denver, a major metropolitan area with its inherent traffic problems;

3) Interstate Highway 30 to Bolten Ranch is closed about 10 percent of the year due to snow and wind;

4) Severe weather patterns which could restrict training from four to six months each year;

5) The ranch provides habitat for the American Bald Eagle in addition to deer, elk and artelope prevalent in the area;

6) Part of the watershed for the town of Rawlins, Wyoming is included in the parcel; and

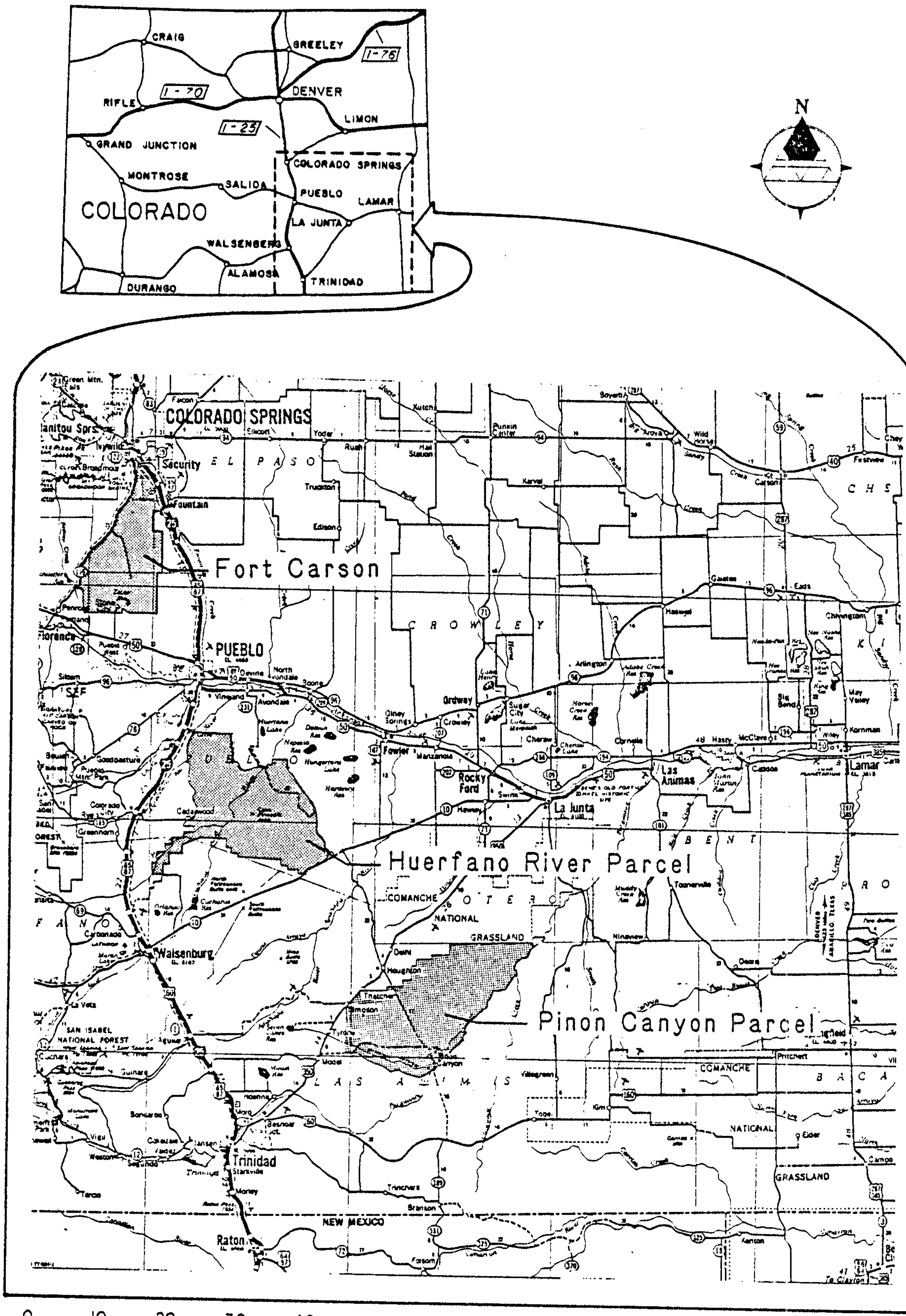
7) Complex land/mineral rights ownership would complicate land acquisition. The area is part of the Union Pacific Railroad grant and is fragmented into checkerboard sections owned by private landowners, the Federal government, and the state.

Items 2-7 are serious disadvantages but could be mitigated. Item 1, distance from Fort Carson, is a critical factor and cannot be overcome. The Bolten Ranch is therefore not a reasonable or feasible alternative.

2.3.3 Parcels Meeting Criteria

Huerfano River and Pinon Canyon Parcels

As shown on Table 2-1, these parcels are reasonable and feasible alternatives to satisfy the Fort Carson requirement for additional maneuver training land. The remainder of this EIS focuses on the available land management alternatives and the respective impacts if either the Huerfano River or Pinon Canyon Parcel were to be obtained and used as a remote training site. Locations of Huerfano River and Pinon Canyon Parcels are shown on Figure 2-1.



0 10 20 30 40

SCALE = MILES

LOCATION MAP

FIGURE 2-1

DAMES & MOORE

2.4 DEVELOPMENT OF LAND USE AND MANAGEMENT PLANS

As shown on Table 2-1, the Huerfano River and Pinon Canyon parcels would satisfy the requirement for additional maneuver training land and are reasonable and feasible alternatives. To assess land management options and projected impacts, should either parcel be used as a remote training site, a Land Use and Management Plan (LUMP) was developed for each parcel. The LUMP coordinates current land characteristics and proposed military training exercises into use scenarios for the parcel. Discussions of the parcels are presented in alphabetical order. No preference or inequality is implied. To avoid redundancy, discussions of the Pinon Canyon site may refer to the Huerfano River discussion when similar. Differences between the alternatives are therefore emphasized.

2.4.1 Scenario Concept

The climate of the parcels has influenced the development of poorly developed, fragile soils that are protected from erosion by weak and sparse plant cover. The LUMP would emphasize range plant management as the foremost objective. The plan would include the establishment of a protective plant cover, where needed, and the protection of existing plant cover throughout military training use of the parcel. A range plant management plan favoring natural vegetative communities would help to provide suitable wildlife habitat.

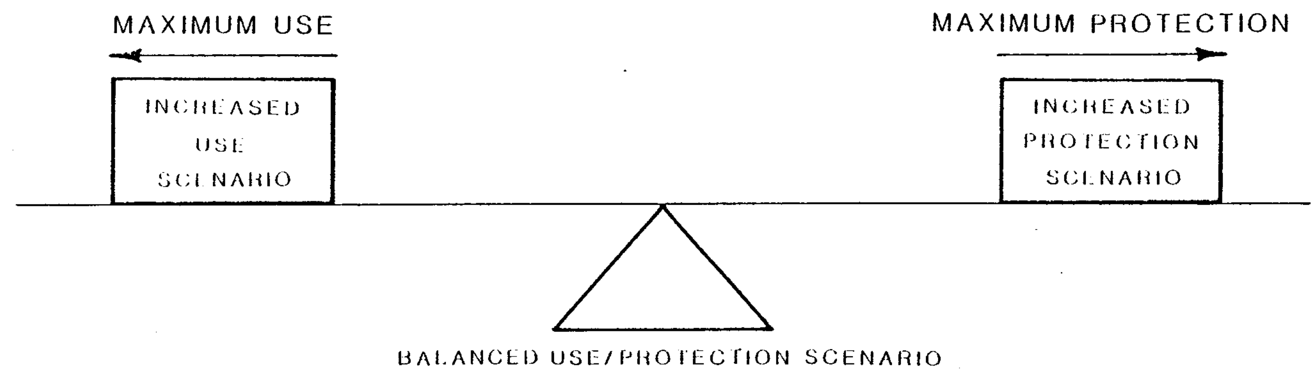
To evaluate land use and management alternatives for proposed expansion of Fort Carson military training lands, projected courses of action were developed for the use, management and treatment of the land for military training. Three courses of action, or scenarios, were formulated using the known impacts of military training at Fort Carson on the environment. Each scenario is intended to provide a management system for reducing risk of irreversible damage to land resources and to allow long-term use of the land. The scenarios are shown on Figure 2-2 and described as follows:

The Increased Protection Scenario represents the highest level of protection of the environment among the three scenarios. It is intended to provide training use while allowing concerted resource conservation.

The Increased Use Scenario represents the highest level of use for military training among the three scenarios. It is intended to provide some resource protection while allowing increased training use.

The Balanced Use/Protection Scenario represents the mid-level of military training use and protection of the land resource. It is intended to maintain a balance that includes environmental protection and use of the land.

The major variables applied to each scenario in the development of the LUMP were:



THE <u>INCREASED USE SCENARIO</u> MAXIMIZES MILITARY TRAINING USE WHILE ALLOWING SOME RESOURCE PROTECTION.

THE <u>INCREASED PROTECTION SCENARIO</u> MAXIMIZES THE PROTECTION OF THE ENVIRONMENT WHILE PROVIDING MILITARY TRAINING USE.

THE <u>BALANCED USE/PROTECTION SCENARIO</u> REPRESENTS THE MID-LEVEL OF MILITARY TRAINING USE AND PROTECTION OF THE LAND RESOURCE.

FIGURE 2-2 SCENARIO BALANCE BETWEEN USE AND PROTECTION

DAMES & MOORE

1) Training intensity;
2) Time of use-deferment and rotation;
3) Boundary (preferred/revised versus offered/original boundaries);
4) Limited and restricted use areas;
5) Location of the cantonment area;
6) Road development; and
7) River crossings.

Of the seven variables, all but training intensity will be self-explanatory. Training intensity depends upon carrying capacity, stability of range sites and vegetative condition.

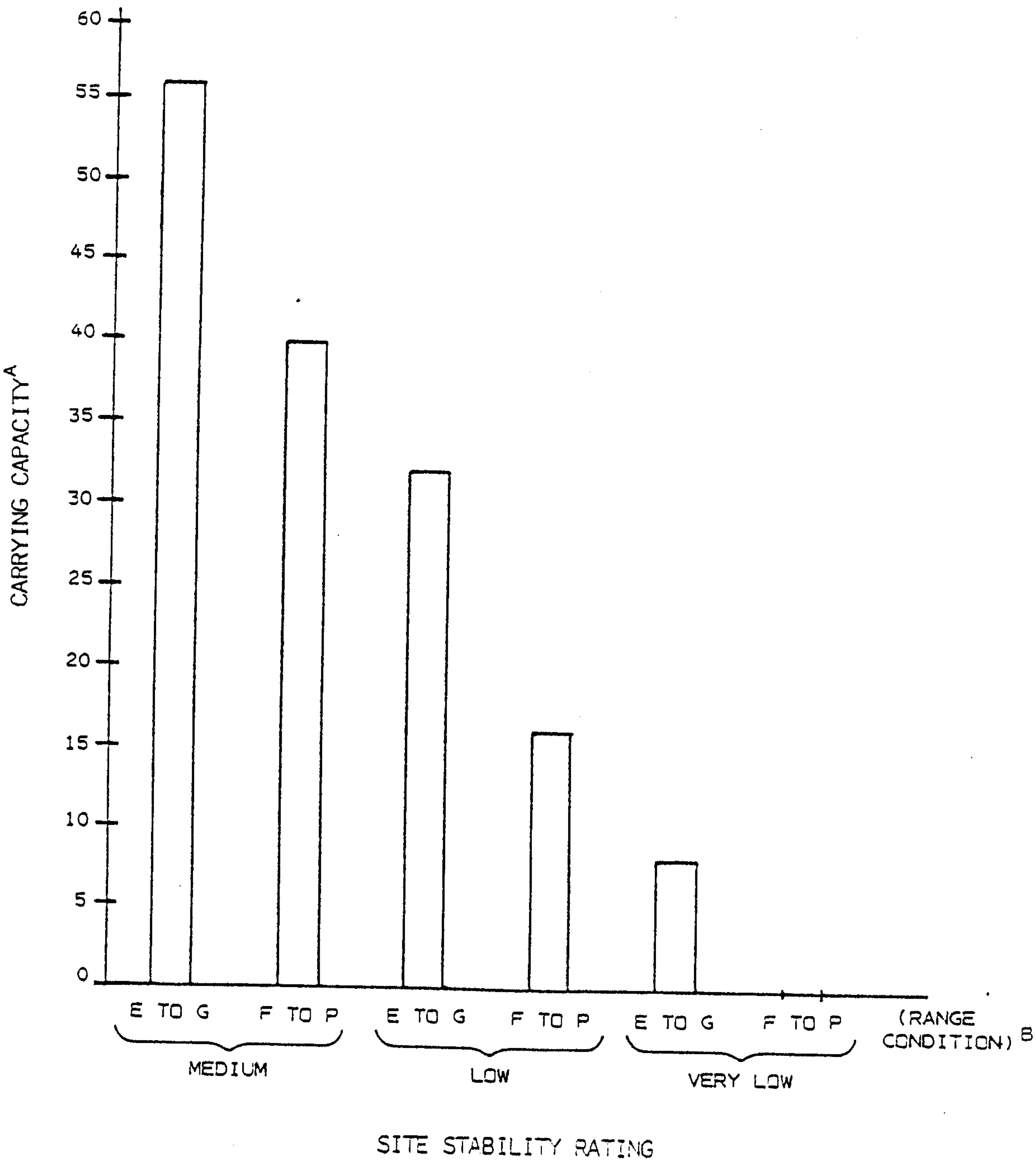
2.4.2 Range Site Stability and Vegetative Condition

Soils were grouped into range sites through field studies identifying natural occurrence of plant communities and soil. Range site stability is related to the type and rate of recovery of a site following such disturbances as grazing, plowing, traffic, and mechanized infantry training use. Site stability is also based on the feasibility and effectiveness of artificial treatment that can accelerate the recovery of an affected site. A range site with a high stability rating has soils and natural vegetation to allow 1) disturbance to be tolerated and less permanent damage sustained; 2) recovery, through natural plant succession, more rapidly than a lower stability site; and 3) response to artificial land recovery treatment more rapidly than a low stability range site. The inherent stability of range sites and woodlands is related to climate, soil, slope and water availability for plant growth. Where these factors are more favorable, the land has a higher ability to recover from training use impacts. In addition, the present condition of the vegetative cover influences the land's ability to withstand impacts. The range site condition inventory methods used by the Soil Conservation Service have been used to determine range site conditions. As the range site condition improves, the ability of the site to support activity within the various stability classes improves.

2.4.3 Carrying Capacity

The relationship between stability, range condition and carrying capacity is shown in Figure 2-3. The stability rating of a site is based upon local conditions; carrying capacities are therefore applicable wherever range sites have been classified as to stability, such as the Huerfano and Pinon Canyon Parcels. As shown on Figure 2-3, a Medium stability range site, with Fair to Poor vegetative condition, can accommodate military vehicle activity of 40 vehicle-days on 100 acres each year.

Although the concept of carrying capacity is generally used for grazing and wildlife, its application to military training was first



[A] CARRYING CAPACITY IS EXPRESSED IN ALLOWABLE YEARLY VEHICLE DAYS ON 100 ACRES. A WHEELED VEHICLE USES 1 DAY FOR 4 HOURS OF OVERLAND MOVEMENT, A TRACKED VEHICLE USES 2 VEHICLE DAYS FOR EACH 4 HOURS OF OVERLAND MOVEMENT

[B] RANGE CONDITION; E TO G = EXCELLENT TO GOOD, F TO P = FAIR TO POOR, RANGE CONDITION CLASS USED BY SCS.

ESTIMATED CARRYING CAPACITY FOR SITES USING STABILITY RATINGS AND RANGE SITE CONDITION CLASSES

FIGURE 2-3

DAMES & MOORE

developed in the Land Use and Management Plan for Fort Carson in 1977. Carrying capacities of rangelands and woodlands for livestock and wildlife are determined by a knowledge of food and habitat requirements, quantity and quality of food produced by the vegetation, watershed and erosion control needs, and other considerations. In deriving the carrying capacity for military training operations, the intensity of use that the land can sustain has been determined.

In the absence of quantitative data as available for livestock and wildlife, carrying capacities for military training use were derived from field estimates and applied ecological principles. Soil and range conservationists used the range site inventory and the history of military training use at Fort Carson to determine the effects of maneuver training. These were combined with repeated observations of the soils and vegetation on Fort Carson to derive the tolerance level or carrying capacity of each site. In this analysis the common denominator of military use was the vehicle-day, which was defined as a four hour period of activity per day for a wheeled vehicle.

Carrying capacities are practical bases for estimating the intensity of military training operations that can be imposed on a land area. The intensity of use, if within the carrying capacity, would reduce the risk of irreversible damage to soils and vegetation. The use of carrying capacity is combined with control of time of use, frequency of use, and the application of enhancement practices to protect the soil and vegetation resources of the parcel and to form the basis of the land use and management planning presented here.

Land use and treatment are planned to coordinate range site stability to intensity, time, and frequency of use. Plant cover is the only practical protection against erosion and land deterioration on the parcels; the prime objective of the LUMP is therefore to maintain the best attainable range cover on each site.

2.4.4 Continuing Analysis/Management of Training Intensity

The carrying capacities developed on the Fort Carson military reservation reflect long-term experience with land response to military training use. As military training evolves and changes, these training intensities may change due to new patterns of use or the advent of more effective mitigation measures.

Training intensity and timing will be reviewed annually to determine the optimum level of adequate land recovery from impacts. Due to natural climatic variability in both the Pinon Canyon and Huerfano River parcels, the identification of land response will probably involve an entire five-year rotation period with yearly systematic records of the impact levels experienced and mitigation success. Professional evaluation by Fort Carson Environmental staff, with assistance as requested from

Federal and State agencies and soil conservation districts will form the basis of this record, which will supply adequate documentation for altering the timing or intensity of training use.

2.4.5 Natural Resource Management Measures

The following listed descriptions of soil and water conservation measures are closely associated with the ultimate effectiveness of the planned environmental management set forth in the major variables for each parcel. The measures pertain to both parcels are intended to augment the treatment and management represented in the variables.

Actions to be Taken Prior to Military Training Use

1) Construct boundary fences and fences around soil and wildlife protective areas designed for wildlife movement;

2) Initiate wildlife studies to allow for development of a comprehensive wildlife management program;

3) Develop and implement detailed land conservation plans for each management unit that will include:

a) Maintaining and repairing as needed all conservation structures presently in place;

b) Construct water diversions to conduct runoff water away from active headcuts, and build basin terraces on critical upper watershed areas;

c) Construction of erosion control dams and sediment interception structures wherever required;

d) Interseed or pitter-seed land having inferior plant cover but which can be upgraded by introducing adapted, superior species into the existing cover;

e) Reseed all feasible areas in Poor range condition. Areas included in this category are Saline Overflow, Alkaline Plains, old fields and barren acreages around stockwatering places, and all primary access roadsides;

4) Maintain existing and construct new gravel roads to service all Management Units. These major access roads will be graveled to minimize soil erosion and the generation of particulates;

5) Establish monitoring networks for water quality, air quality and sound levels to ensure compliance with all applicable regulations and to facilitate analysis of long-term trends;

6) Initiate a cultural resource survey to identify and subsequently protect all such resources as required by Federal regulation. Refer to the Memorandum of Understanding in Appendix J for additional detail; and

7) Conduct a detailed vegetation survey on aerial photos taken in September of the first year of ownership of the parcel. Detailed inventory areas will be chosen to represent range sites within each management unit. For monitoring purposes, aerial photos would then be taken in the September following a full rotational cycle, and levels of impacts occuring on the parcel identified by an impact survey using photos and coordinated field studies. Representative areas would be chosen to assess the impact response of each range site. This, in addition to records of mitigation success, would be used to evaluate training intensity levels, define new off-limits areas, and to suggest additional training exercises to utilize little-used areas.

Actions to be Taken on a Continuing Basis Once Military Training is Initiated

In addition, Items 2 through 5 and 7 above would be continuing efforts as long as the site would be used for military training. A comprehensive conservation plan detailing ongoing actions would be prepared and implemented as needed. The plan would include the following actions, for all scenarios of use.

1) Implement actions called for in comprehensive wildlife management program.

2) Identify areas through careful surveillance that require prompt application of remedial measures to reestablish plant cover and control erosion. Appropriate steps include:

a) Reseed in accordance with guidance from the U.S. Soil Conservation Service, U.S. Forest Service and local landowner experience. Suitable seeding equipment, superior adapted plant materials, and favorable time of seeding would be incorporated into reseeding projects;

b) Protect problem areas exposed to wind erosion by furrowing, pitting or ripping the soil surface to roughen the land against the force of wind action;

c) Equip selected track vehicles with seed-dribblers to plant adapted seed into soils traversed by the vehicles during the reseeding period;

d) Concentrate the main range seeding program at the end of the use period to allow the longest plant establishment time;

4) Identify commonly used lookouts, drainage crossings, bivouac areas and trails that would continue to experience heavy use and artificially protected surfaces and reduce slope lengths to minimize wind and water erosion;

5) Implement an experimental grazing program to determine if and at what level grazing can be accommodated; and

6) Training deferment will occur throughout the year whenever excessive soil moisture conditions develop. Excessive moisture conditions with a field test for easy identification of conditions by military personnel are defined in Appendix A (page A-32). This additional deferment would be incorporated because maneuver training under high soil moisture conditions causes abnormally severe vegetation damage and soil rutting and compaction. This deferment will be implemented by:

a) Not initiating training if soil moisture conditions are excessive;

b) Halting active maneuvers in place on a temporary basis when excessive soil moisture conditions occur and are due to localized short-term precipitation events; and

c) Halting maneuver training and returning vehicles to the cantonment area by the nearest improved tank trail or road if the condition is predicted to be a widespread storm that will be of long duration (longer than one day).

These interruptions will reduce the damage to soils and vegetation significantly. It is expected that these unplanned interruptions can be incorporated into the exercise training and will not necessarily inhibit the success of the exercise.

2.5 HUERFANO RIVER PARCEL LAND USE AND MANAGEMENT PLAN (LUMP)

The Huerfano River Parcel was divided into five management units to allow development of a 2-unit use, 3-year rest and 3-unit use, 2-year rest rotation plan. These units were delineated on the basis of watershed and topographic boundaries to assure easy recognition by military personnel. Figure 2-4 (in pocket) shows the boundaries of Management Units A-E, the wildlife protection areas and buffer zones. Table 2-2 summarizes size and land stability characteristics. The units are described in Appendix A. The Management Units range in size from 30,757 acres (12,447 hectares) to 46,771 acres (18,928 hectares). Each Management Unit has a combination of open plains and topographically complex ridges and hills to meet military training needs. Maps and more technical descriptions of the Management Units and wildlife protection area are part of Appendix A.

TABLE 2-2

MANAGEMENT UNITS, HUERFANO RIVER PARCEL

Management Unit	Acres[1] (Hectares)	Protected Areas of Non-Use	Total Usable	Land Stability (percent) Medium	Low	Very Low
A						
Balanced Use/Protection and Increased Use	42,956 (17,384)	3,773 (1,527)	39,183 (15,857)	77.1	22.4	0.5
Increased Protection[2]	0	0	0			
B						
Balanced Use/Protection and Increased Use	30,757 (12,447)	865 (350)	29,892 (12,097)	72.8	25.5	1.8
Increased Protection	40,239 (16,284)	1,343 (194)	38,896 (16,091)	72.6	26.0	1.4
C	44,189 (17,883)	1,262 (511)	42,927 (17,372)	88.6	6.8	4.5
D	46,771 (18,928)	1,985 (803)	44,786 (18,124)	84.4	14.9	0.7
E	40,434 (16,363)	825 (334)	39,609 (16,030)	84.1	9.8	6.2
Wildlife Protection	19,869 (8,041)	19,869 (8,041)	0			
TOTAL						
Balanced Use/Protection and Increased Use	224,976 (91,048)	28,579 (11,566)	196,397 (79,480)			
Increased Protection	191,502 (77,501)	25,284 (10,232)	166,218 (67,268)			

[1]Acres obtained by planimetry, and include only preferred boundary.

[2]Under the Increased Protection Scenario, the Four Mile Creek drainage area from Unit A would be added to Unit B, the remainder of Unit A would not be used.

2.5.1 LUMP Variables--All Scenarios

The seven major land use variables listed in Section 2.4.1 were utilized to develop a management plan for the three different scenarios. The variables will first be discussed in terms of all elements that apply to each scenario. The three scenarios will then be presented with their differences emphasized.

Training Intensity

The amount of training to be conducted each year will vary depending on the management units in use. Training intensities for all scenarios are limited by the carrying capacities of the management units, and are detailed in the individual scenario discussions.

Time of Use - Rotation and Deferment

Rotation

The Management Unit rotation plan is unique for each of the scenarios as illustrated in Figure 2-5. For example, the Balanced Use/Protection Scenario calls for two units to be used each year. A particular unit would be used for two years and then rested for three. The time of annual rotation for all scenarios is the start of the growing season deferment period to allow timely mitigation before the main part of the growing season. The rotation system allows for consecutive years of rest for maximum resource recovery. The routine resting of Management Units is an integral element of this acquisition proposal and is the rationale for obtaining more land than would be trained on at any one time. The only activities that would be allowed on resting Management Units would include potential grazing, hunting, baseline natural resource studies and tours by interested agencies, groups or individuals.

Deferment

Each scenario would also have scheduled deferment periods for the Management Units in use (Figure 2-6). The major deferment time encompasses a portion of the growing season to protect the vegetation. Soil and water conservation measures would be installed as practicable, before May 1 for maximum water erosion reduction. Major seeding programs would occur from March 1 to May 1 although seed dribblers would be installed on or before February 15. The December 15 to January 15 deferment period corresponds to the traditional holiday period and would allow surface protection and roughening measures to be installed before the high wind erosion period.

In addition to the schedule of the growing season deferment period, additional deferment would occur throughout the year whenever excessive soil moisture conditions develop, as discussed in Section 2.4.1.

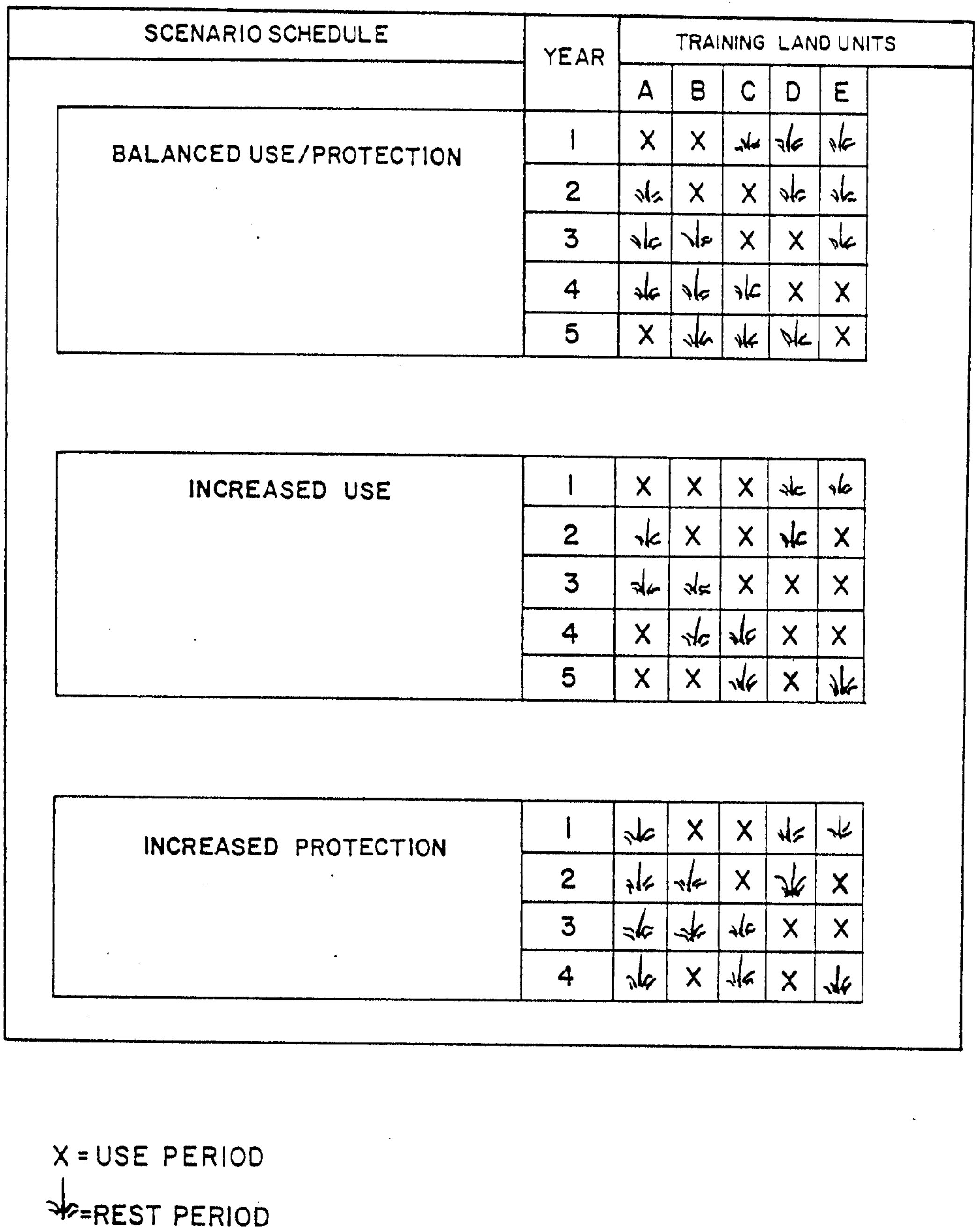
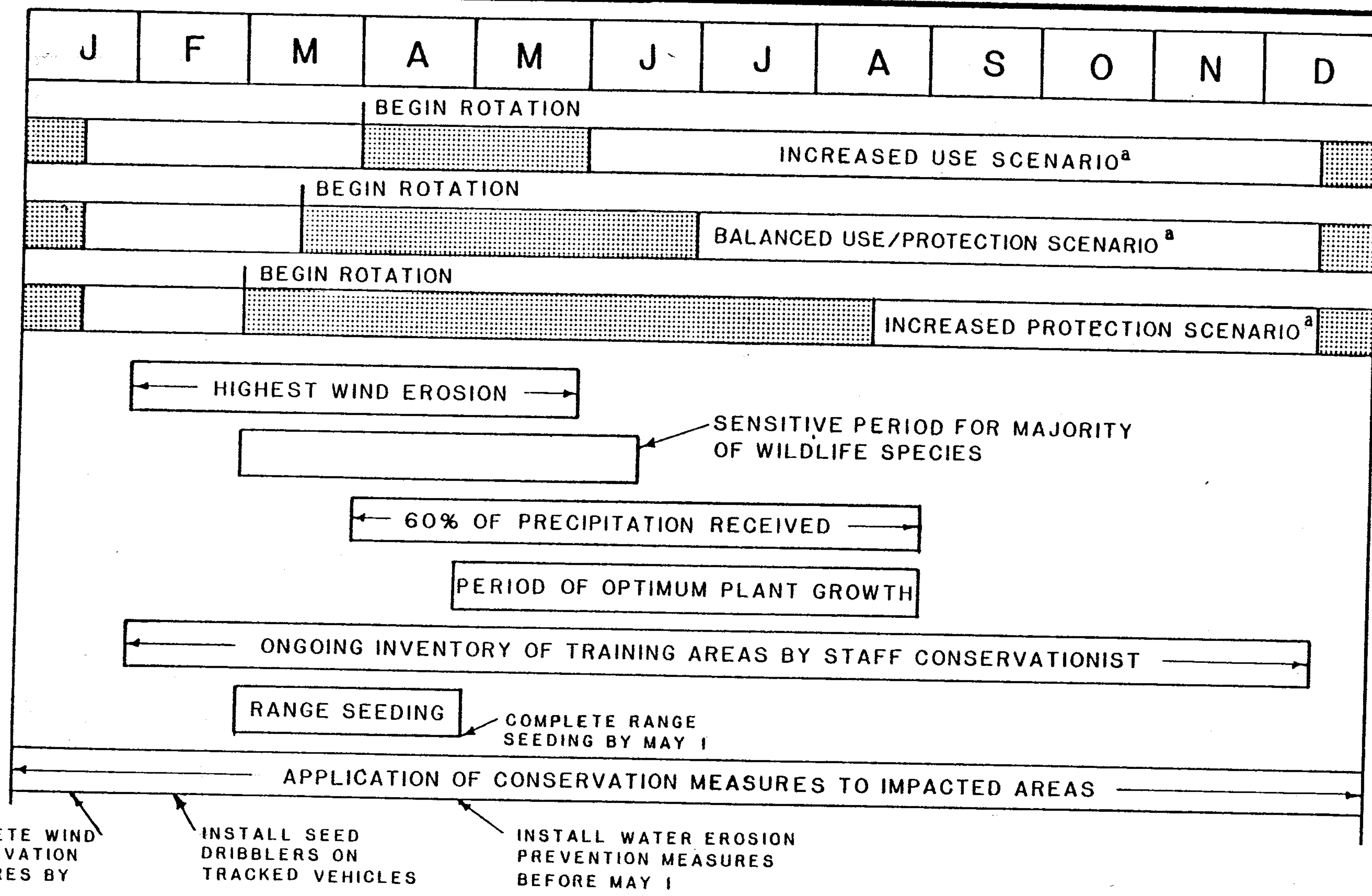


FIGURE 2-5 SYSTEM OF REST – ROTATION FOR THE HUERFANO RIVER PARCEL.



[a] ACTUAL MILITARY TRAINING USE WILL BE 60% OR LESS OF THE AVAILABLE DAYS SHOWN

DEFERMENT AND NON-USE PERIODS

ANNUAL PLAN FOR PARCEL USE AND MANAGEMENT

DAMES & MOORE

FIGURE 2-6

Boundary

The boundary of the parcel initially offered for sale to the Army is shown on Figure 2-4. Major modifications were made to establish the "preferred" boundary along natural topographic and man-made delimiting features such as roads. These modifications are also reflected on Figure 2-4 and discussed below.

1) The offered property along the entire east side of the parcel was adjusted inward to the Pipeline Road and Red Top Ranch Road to avoid serious transportation problems that would result if access to those roads was restricted.

2) The non-offered property east of Unit A and north of Unit B was expanded to enlarge the maneuver corridor connecting Units A and B with C and D.

Limited and Restricted Use Areas

Five soil protection areas would be established within the parcel as shown on Figure 2-4. These areas would also afford protection to a potentially occurring endangered plant species, Haplopappus fremontii monocephalus, and would be off limits to vehicles.

The major portion of the Huerfano River canyon and all of the Cucharas that was offered for sale is not required for military training. The portion of the canyon within the main area of the site and a 1/4-mile (0.4 kilometer) buffer zone on either side would be requested and subsequently managed as a wildlife protection area and possibly a state natural area. No military use would occur in this area, and no helicopter use would occur below the canyon rim. The "tail" (extended portion) of the canyon is not required and would not be requested. However, because it represents a small part of a large property, the government may, in fact, acquire it. If that occurs, a decision will be made at the time whether to retain and manage it in accordance with the rest of the canyon, turn it over to another government agency for management, or dispose of it according to government procedures.

Location of the Cantonment Area

The cantonment area would be located near the Cedarwood rail siding in the southwestern corner of Unit B (Figure 2-4). The existing two-way rail siding minimizes transportation costs, and transportation of vehicles and troops to the parcel would affect a minimum number of area residents because of the interstate exit. Further description of Cedarwood and other cantonment areas considered are discussed in Appendix A. The provision of potable water is an unresolved issue. Reported water yields from known wells in the vicinity of the Cedarwood cantonment are low (U.S. Army Environmental Feasibility Study, Huerfano Site, date unknown; Personal communication, Robert Penley, U.S. Geological Survey, January 23, 1980). Surface water supply is discussed in Appendix E. Since these data indicate costly development of a water supply for the Cedarwood cantonment, an alternative supply source may be water hauled to the site from some municipality.

Road Development

Existing roads on the Huerfano River Parcel are shown on Figure 2-4. Road development would include the design and installation of improved gravel roads to each Management Unit. As use patterns are established, major trails, commonly used lookout points and other extremely impacted areas would be stabilized.

River Crossings

River crossings would include the construction of a bridge across the Huerfano Canyon within the wildlife protection area. The most likely location for the bridge would be somewhere between Sheep and Poleline Canyons east of the cantonment area. This bridge would be used to facilitate troop movement from the cantonment area into Units C, D and E, but would not be used as a focal point during military exercises. Fording of the lower Huerfano River below the wildlife area would be allowed except in periods of local flooding; however, diversion ditches which carry water to users outside the parcel would be protected. A gravel road already crosses the river in this area. Other commonly used fording areas would be identified as training use occurs, and these would be rip-rapped to stabilize channel bottoms and banks.

Vehicle crossings would not be conducted on the St. Charles and Cucharas Rivers. Fording of all other streams and drainages would be conducted along existing trails and additional trails developed to cross channel bottoms. Fording would be limited to water depths in which the military vehicles can cross safely.

2.5.2 Balanced Use/Protection Scenario

Training Intensity

This scenario would set the training intensity at the carrying capacity level. The acreages available for training in any year range from 68,351 usable acres (27,662 hectares) in the smallest two units to 86,173 acres (34,866 hectares) in the largest two units. The capacity for training use ranges from 22,802 to 31,803 vehicle days, which would allow approximately 2.1 to 2.9 brigade training periods (Table 2-3).

Time of Use - Rotation and Deferment

The growing season deferment period for this scenario is from March 15 - June 30. This period would provide for time to implement

TABLE 2-3

BALANCED USE/PROTECTION SCENARIO, HUERFANO RIVER PARCEL

Summary of Available Training Land and Vehicle Use

Unit Rotation	Training Acres Available[1]	Medium Stability Acres[2]	Low Stability Acres[2]	Available Vehicle-Days[3]	Brigade Training Periods Possible[4]	Division Exercises Possible	Reserve Training Periods Possible
AB	68,351	49,443	18,908	22,802	2.1	.7	2.4
BC	70,434	59,867	10,567	25,638	2.4	.8	2.7
CD	85,549	72,479	13,070	31,083	2.9	1.0	3.3
DE	81,609	67,982	13,627	29,373	2.7	.9	3.1
EA	86,173	59,357	16,816	26,433	2.5	.8	2.8

[1]Excludes rockland occupying 40% of TrG unit, all protected areas, and all very low stability areas.

[2]All range sites in the parcel are in fair-poor condition.

[3]A vehicle-day is defined as 4 hours of operational time of a wheeled vehicle and 2 hours of operational time of a tracked vehicle. This is due to the increased impact caused by tracked vehicles on soils and vegetation. A four-hour period is estimated as the average time during an exercise day in which all vehicles are being driven. The operation of tracked vehicles, therefore, consumes twice as many vehicle-days as wheeled vehicles.

[4]Computed by dividing the available vehicle-days by the vehicle-days consumed by the applicable unit training.

protection measures before the growing season and for some growth and recovery of the range vegetation. Deferment periods are illustrated in Figure 2-6.

Road Development

In addition to stabilizing main roads, major trails, lookout points and other extremely impacted areas that become apparent as use patterns develop, minor trails and severely impacted areas would be removed from use or stabilized as required.

2.5.3 Increased Use Scenario

Training Intensity

This scenario would set the training intensity at a level 15 percent above the carrying capacity. The acreages available for training in any year range from 107,592 usable acres (43,542 hectares) in the smallest three units to 122,707 usable acres (49,660 hectares) in the largest three-unit combination. The capacity for training use ranges from 44,035 to 51,590 vehicle-days, which would allow 4.1 to 4.8 brigade training periods (Table 2-4).

Time of Use - Rotation and Deferment

This scenario includes a growing season training deferment for the period April 1 - June 1, as shown in Figure 2-6. This is the absolute minimum period required to afford any significant vegetative protection. In addition, it is intended that the range seeding program be concentrated at the end of the third year of use to allow two full years for plant establishment.

2.5.4 Increased Protection Scenario

Training Intensity

This scenario would set the training intensity at the carrying capacity level. The acreages available for training in any year range from 78,526 usable acres (31,772 hectares) in the smallest two-unit combination to 83,219 acres (33,670 hectares) in the largest two units. The capacity for military use ranges from 28,656 to 29,373 vehicle-days, which would allow about 2.7 brigade training periods for each combination of units (Table 2-5).

Time of Use - Rotation and Deferment

The rotation plan for this scenario is unique because much of Unit A would be totally deferred as discussed below. The 4-unit rotation schedule is shown on Figure 2-5.

TABLE 2-4

INCREASED USE, HUERFANO RIVER PARCEL

Summary of Available Training Land and Vehicle Use

Unit Rotation	Training Acres Available[1]	Medium Stability Acres[2]	Low Stability Acres[2]	Available Vehicle-Days[3] (+15%)[4]	Brigade Training Periods Possible[5]	Division Exercises Possible	Reserve Training Periods Possible
ABC	109,449	86,582	22,867	44,035	4.1	1.4	4.7
BCE	107,592	92,509	15,083	45,330	4.2	1.4	4.8
CDE	122,707	105,121	17,586	51,590	4.8	1.6	5.5
DEA	120,624	94,697	25,927	48,332	4.5	1.5	5.1
DAB	112,802	84,783	28,019	44,155	4.1	1.4	4.7

[1]Excludes rockland occupying 40% of TrG unit, all protected areas, and all very low stability areas

[2]All range sites in the parcel are in fair-poor condition.

[3]A vehicle-day is defined as 4 hours of operational time of a wheeled vehicle and 2 hours of operational time of a tracked vehicle. This is due to the increased impact caused by tracked vehicles on soils and vegetation. A four-hour period is estimated as the average time during an exercise day in which all vehicles are being driven. The operation of tracked vehicles, therefore, consumes twice as many vehicle-days as wheeled vehicles.

[4]With ongoing monitoring of units used for training exercises and implementation of the proposed mitigation procedures, it is estimated that carrying capacities can be exceeded by 15%, with moderate long-term resource degradation resulting.

[5]Computed by dividing the available vehicle-days by the vehicle-days consumed by the applicable unit training.

TABLE 2-5

INCREASED PROTECTION, HUERFANO RIVER PARCEL

Summary of Available Training Land and Vehicle Use

Unit Rotation	Training Acres Available[1]	Medium Stability Acres[2]	Low Stability Acres[2]	Available Vehicle-Days[3]	Brigade Training Periods Possible[4]	Division Exercises Possible	Reserve Training Periods Possible
BC	79,866	66,157	13,709	28,656	2.7	.9	3.0
CE	78,526	69,781	8,745	29,311	2.7	.9	3.1
DE	81,609	67,982	13,627	29,373	2.7	.9	3.1
BD	83,219	64,358	18,861	28,761	2.7	.9	3.1

[1]Excludes rockland occupying 40% of TrG unit, all protected areas, and all very low stability areas.

[2]All range sites in the parcel are in fair-poor condition.

[3]A vehicle-day is defined as 4 hours of operational time of a wheeled vehicle and 2 hours of operational time of a tracked vehicle. This is due to the increased impact caused by tracked vehicles on soils and vegetation. A four-hour period is estimated as the average time during an exercise day in which all vehicles are being driven. The operation of tracked vehicles, therefore, consumes twice as many vehicle-days as wheeled vehicles.

[4]Computed by dividing the available vehicle-days by the vehicle-days consumed by the applicable unit training.

This scenario would include a growing season deferment from March 1 as shown on Figure 2-6. This period would provide more protection during the freeze-thaw time and the majority of the growing season. Coincidentally, the March time period corresponds to sensitive times of wildlife activity.

All St. Charles River drainages, which are a majority of Unit A, would be eliminated from use to reduce potential fugitive dust emissions to Pueblo and to safeguard the water quality of the St. Charles River. The Four-Mile Creek watershed which forms the southern boundary of Unit A in the other two scenarios would be placed in Unit B to increase available maneuver acreages (see Figure 2-4). The units that would be considered in rotation, therefore, are Units B, C, D and E.

Time of Use - Rotation and Deferment

In addition, this scenario includes total deferment during times of drought. Drought conditions would be analyzed on a monthly basis starting in March and continued until September. Deferment would occur when the cumulative precipitation starting in March falls below the values listed below. Use would start again when the cumulative precipitation rises above the values listed below.

Month	Cumulative Precipitation (Inches) (Centimeters)
March	0.35 (0.89)
April	0.69 (1.75)
May	1.33 (3.38)
June	1.61 (4.09)
July	2.45 (6.22)
August	3.26 (8.28)
September	3.55 (9.02)

Source: Colorado Monthly Temperature and Precipitation Summary for Period 1951-1970. Colorado State Climatologist. Precipitation values are the 20 percent probability occurrences for Butler Ranch.

If at the end of September, the cumulative precipitation from March to September had not exceeded 3.55 inches (9.02 centimeters), total deferment would occur until such time that the above conditions are met.

Limited and Restricted Use Areas

In addition to no vehicle use of any wildlife or soil protection area, no dismounted troop use would be allowed.

Road Development

In addition to stabilizing main roads, major trails, lookout points and other extremely impacted areas that become apparent as use patterns develop, minor trails and other severely impacted areas would be removed from use or stabilized as required.

2.5.5 Comparison of Scenarios

The three scenarios are compared on Table 2-6. Between 2.7 and 4.8 brigade training periods can be performed, according to the scenario selected; potential division exercises range between 0.7 and 1.6; and reserve training periods range between 2.4 and 5.5. Thus, a variety of training exercises to accommodate military training needs can be selected. As shown on Figure 2-7, the Increased Use Scenario includes training use that exceeds carrying capacity by 15 percent, and includes a 2-year rest period as does the Increased Protection Scenario. The Balanced Use/Protection Scenario contains a 3-year rest period. The key natural resource protection measures for all scenarios are summarized in Figure 2-7.

2.6 PINON CANYON PARCEL LAND USE AND MANAGEMENT PLAN (LUMP)

The Pinon Canyon Parcel was divided into five Management Units and one optional Management Unit (Unit F) to allow development of 2-unit use, 3-year rest and 3-unit use, 2-year rest rotation plans. These units were delineated to conform with roads and topographic features to help in recognition of boundaries. Figure 2-8 (in pocket) shows the boundaries of Management Units A-F, a potential wildlife protection area and buffer zones. Table 2-7 summarizes size and land stability characteristics of each Unit. The Units range in size from 38,786 acres (15,697 hectares) to 50,299 acres (20,356 hectares). Each Management Unit has a combination of open plains and topographically complex ridges and hills to meet military training needs. The units are described in more technical detail in Appendix A.

2.6.1 LUMP Variables--All Scenarios

The seven major land use variables listed in Section 2.4.1 were utilized to develop a mangement plan for the three different scenarios. The variables will first be discussed in terms of the elements that apply to each scenario. The three scenarios will then be presented and their differences emphasized.

Training Intensity

Training intensities for all scenarios are limited by the carrying capacities of the Management Units. The amount of training to be conducted each year would vary depending upon the Management Units in use and is discussed later for each scenario.

TABLE 2-6

HUERFANO RIVER PARCEL

Comparison of Scenarios

Scenario	Balanced Use/Protection Smallest 2 Units	Balanced Use/Protection Largest 2 Units	Increased Use Smallest 2 Units	Increased Use Largest 2 Units	Increased Protection Smallest 2 Units	Increased Protection Largest 2 Units
Vehicle-day-use allowed yearly	22,802 (AB)	31,083 (CD)	44,035 (ABC)	51,590 (CDE)	28,656 (BC)	29,373 (DE)
Available Brigade Training Periods	2.1	2.9	4.1	4.8	0-2.7[1]	0-2.7[1]
Available Division Exercises	.7	1.0	1.4	1.6	.9	.9
Available Reserve Training Periods	2.4	3.3	4.7	5.5	3.0	3.1

[1]Due to the drought deferment required in this scenario, no military exercises would be allowed in an estimated two of every ten years.

Protection Measure		Balanced Use/ Protection	Increased Use	Increased Protection
Time of Use	Deferment	March 15 - June 30 Dec. 15 - Jan. 15 Wet Soil Deferment	April 1 - June 1 Dec. 15 - Jan. 15 Wet Soil Deferment	March 1 - Aug. 15 Dec. 15 - Jan. 15 Drought Deferment Wet Soil Deferment
	Rotation	Units A,B,C,D,E 2 unit use, 3 year rest	Units A,B,C,D,E 3 unit use, 2 year rest	Units B,C,D,E 2 unit use, 2 year rest
Road Devel-opment	Main Roads	Install designed gravel access roads to each unit.		
	Main Trails	Upgrade surfaces of well-traveled areas. (Trails, roads, and lookout points.)		
	Minor Trails	Upgrade surfaces as needed	No Action	Upgrade surfaces as needed
Huerfano River and other major stream crossings		Construct bridge across upper canyon area. Riprap all commonly used fords and banks on Huerfano River. Install sediment collection structures.		
Limited Use Areas	Wildlife Protection Areas	No Military Use.		
	Land Use Protection Buffers	No Vehicular Use.		
	Soil and Endangered Plant Protection Areas	No Vehicular Use.		No use
Training Intensities		Use not to exceed carrying capacities.	Use not to exceed carrying capacities plus 15%.	Use not to exceed carrying capacities.

FIGURE 2-7

COMPARISON OF KEY NATURAL RESOURCE PROTECTION MEASURES

HUERFANO RIVER PARCEL

TABLE 2-7

MANAGEMENT UNITS, PINON CANYON PARCEL

Management Unit	Acres[1] (Hectares)	Protected Areas of Non-Use	Total Usable	Land Stability (percent) Medium	Low	Very Low
A	50,299 (20,356)	2,218 (898)	48,081 (19,458)	63.2	36.8	0
B	48,102 (19,467)	0	48,102 (19,467)	66.2	32.8	1.0
C	39,415 (15,951)	3,250 (1,316)	36,165 (14,636)	86.1	11.4	2.5
D	45,761 (18,519)	0	45,711 (18,519)	83.5	0	16.5
E	38,786 (15,697)	2,284 (925)	36,502 (14,772)	57.1	36.2	6.7
F[2]						
Balanced Use/Protection and Increased Protection	0	0	0			
Increased Use	44,969 (18,199)	0	44,969 (18,199)	89.5	2.8	7.7
Transportation Corridor	5,483 (2,219)	5,483 (2,219)	0	31.4	66.8	1.8
Wildlife Protection Area	29,390 (11,894)	29,390 (11,894)	0			
TOTAL						
Balanced Use/Protection and Increased Protection	257,236 (104,103)	42,625 (17,250)	214,611 (86,853)			
Increased Use	302,205 (122,302)	42,625 (17,250)	259,580 (105,052)			

[1] Acres obtained by planimetry, and include preferred boundary only.

[2] Management Unit F was not included in preferred boundary, but would be utilized in the Increased Use Scenario.

Time of Use--Rotation and Deferment

Rotation

The Management Unit rotation plan for the Balanced Use/Protection and Increased Protection scenarios are identical; two years of use followed by three years of rest, with two units used at one time as illustrated on Figure 2-9. The Increased Use Scenario calls for three years of use followed by two years of rest with three units being used at one time. The timing of consecutive years of rest will allow the maximum natural recovery and response to enhancement measures. Also, the Increased Use Scenario considers the option of using Management Unit F for Reserve Unit training on a 2-year use, 2-year rest rotation.

The time of annual rotation from one Management Unit to another would be the beginning of the growing season deferment period, as illustrated in Figure 2-6. This allows application of natural resource management measures before the main part of the growing season. The routine resting of Management Units is an integral element of this acquisition proposal and is the rationale for obtaining more land than would be trained on at any one time. The only activities that would be allowed on resting Management Units would include potential grazing, hunting, baseline natural resource studies and tours by interested agencies, groups or individuals.

Deferment

Each scenario incorporated scheduled deferment periods for the Management Units in use (refer to Figure 2-6). The major deferment period encompasses a portion of the growing season to protect the vegetation. Soil and water conservation measures would be installed, as practicable, before May 1 for maximum water erosion reduction. Major seeding programs would occur from March 1 to May 1 although seed dribblers would be installed on or before February 15. The December 15 to January 15 deferment period corresponds to the traditional holiday period and would allow surface protection and roughening measures to be installed before the high wind erosion period.

Boundary

The boundary of the parcel initially offered for sale to the Army is shown on Figure 2-8 (in pocket). Major modifications were made to establish the preferred boundary along natural topographic and man-made delimiting features. These modifications are also shown on Figure 2-8 and discussed below:

1) The non-offered property just south of Lockwood Arroyo was included because its only access would have been through the training area and because it was needed to make training more feasible in Management Unit C;

SCENARIO SCHEDULE	YEAR	TRAINING LAND UNITS				
		A	B	C	D	E
BALANCED USE/PROTECTION	1	X	X	ψ	ψ	ψ
	2	ψ	X	X	ψ	ψ
	3	ψ	ψ	X	X	ψ
	4	ψ	ψ	ψ	X	X
	5	X	ψ	ψ	ψ	X
INCREASED USE	1	X	X	X	ψ	ψ
	2	ψ	X	X	ψ	X
	3	ψ	ψ	X	X	X
	4	X	ψ	ψ	X	X
	5	X	X	ψ	ψ	X
INCREASED PROTECTION	1	X	X	ψ	ψ	ψ
	2	ψ	X	X	ψ	ψ
	3	ψ	ψ	X	X	ψ
	4	ψ	ψ	ψ	X	X
	5	X	ψ	ψ	ψ	X

X = USE PERIOD

ψ = REST PERIOD

FIGURE 2-9 SYSTEM OF REST – ROTATION FOR THE PINON CANYON PARCEL.

DAMES & MOORE

2) The non-offered property south to the Van Bremer Arroyo encompassing the Hogback was included because the Hogback itself provides the terrain diversity required for training in Management Units A and B;

3) The non-offered property west to Highway 350 was included to provide direct access from the highway and railroad. This would eliminate major traffic on the old pipeline road from Houghton into the parcel through an area that has been subdivided for potential future residential activity;

4) The northernmost area in Otero County was deleted because it is part of the Comanche National Grasslands and does not contribute to the training usability of the property;

5) The areas south of the Purgatoire River were deleted from the preferred boundary because the river canyon is an insurmountable obstacle to maneuver training. The area south of the Purgatoire River could be used, however, as a possible option for Reserve Unit training as part of the Increased Use Scenario. The existing bridge would be upgraded for access, and Reserve training could be conducted totally within that area; and

6) The boundary between the Management Units and the Purgatoire River canyon was placed about 1/4 mile (0.4 kilometers) back from the canyon rim to protect the canyon area.

Limited and Restricted Use Areas

Five soil protection areas would be established within the parcel as shown on Figure 2-8. These areas would also afford protection to an endangered plant species, Haplopappus fremontii monocephalus, and would be off limits to vehicles.

Major portions of the Purgatoire River canyon are included in the land that was offered for sale. These areas are not required for military training and the Army does not wish to obtain and manage them; however, because these portions of the canyon are generally small parts of larger properties that would be obtained, the government may, in fact, have to acquire them. Any areas so obtained would either be managed by another government agency or disposed of according to government procedures.

The entire canyon is identified as a potential wildlife protection area (Figure 2-8) because both Federal, state and private agencies have indicated that the area is worthy of protection. It should be clear, however, that those portions of the canyon owned by persons wishing to retain them would not be acquired.

Location of the Cantonment Area

The cantonment area would be located in the vicinity of Thatcher in the northwestern corner of Unit A (Figure 2-8). A cantonment near Thatcher would minimize transportation costs, as transportation of vehicles and troops to the parcel would utilize both rail and highway systems. As with the Huerfano River parcel, the provision of potable water is an unresolved issue. It is possible that sufficient on-site water exists and can be developed. As a second option, sufficient water may be available from the city of Trinidad (see Section 3.2.4).

Road Development

Existing roads on the Pinon Canyon Parcel are shown on Figure 2-10. Road development would include the design and installation of improved gravel roads to each Management Unit. Roads would be developed to form training unit boundaries wherever feasible. Special attention would be paid to establishing stabilized trails and roads in the transportation corridor. Major trails created by military use would be stabilized as required. As use patterns develop, major trails, commonly used lookout points, and other extremely impacted areas would be removed from use or stabilized.

River Crossings

There would be no fording of the Purgatoire River. There is a possibility of upgrading a bridge crossing the river to reach Unit F, however, this would be for access only and would not be used during military exercises. Drainages within the training area would be crossed on existing trails and additional trails developed to serve the Management Units.

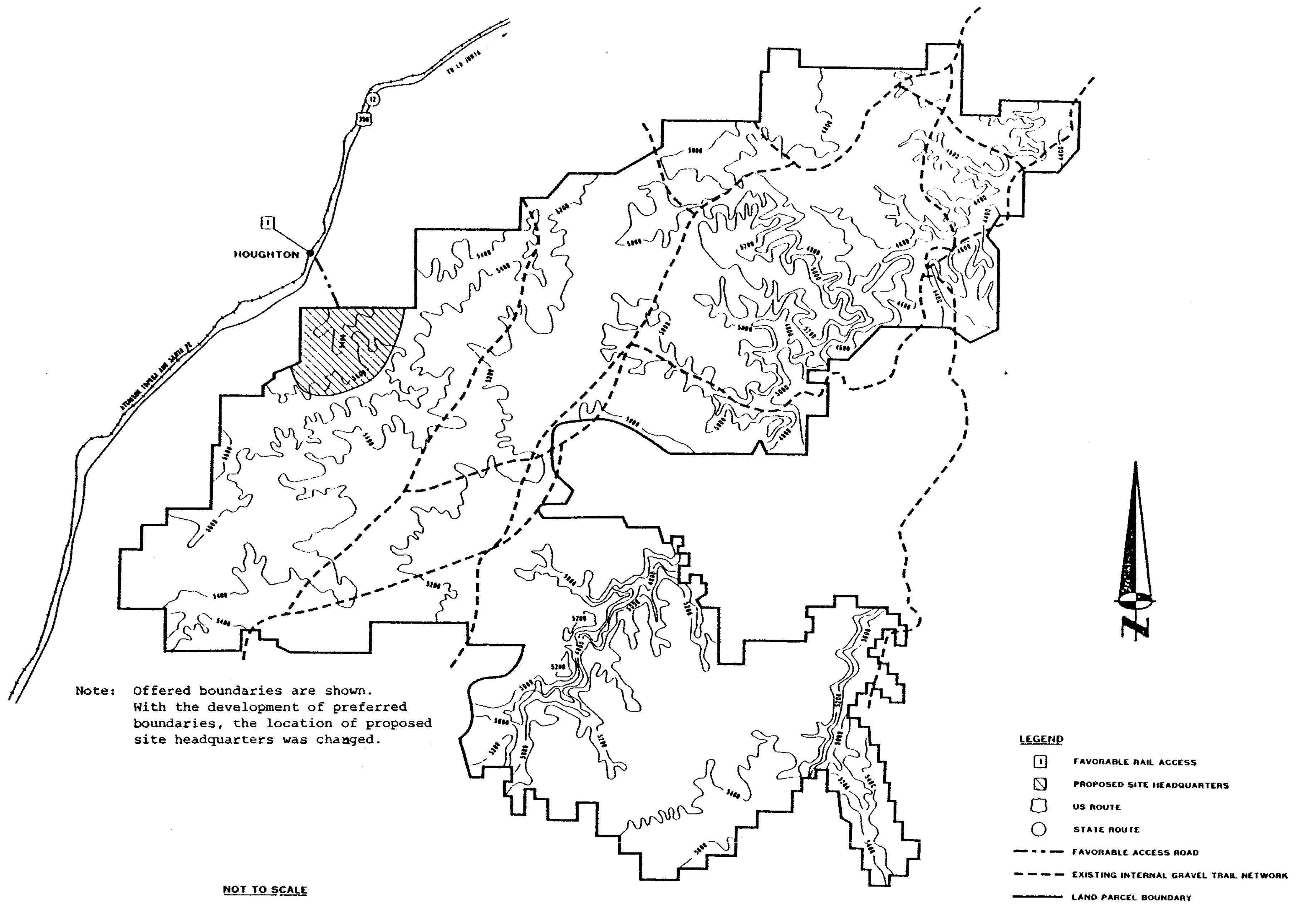
2.6.2 Balanced Use/Protection Scenario

Training Intensity

This scenario would set the training intensity at the carrying capacity level. The acreages available for training in any year range from 72,270 usable acres (29,248 hectares) in the smallest two units to 95,792 acres (38,767 hectares) in the largest two units. The capacity for training use ranges from 25,440 to 30,243 vehicle-days, which would allow approximately 2.4 to 2.8 brigade training periods (Table 2-8).

Time of Use-Rotation and Deferment

Deferment times for the Balanced Use/Protection Scenario are illustrated in Figure 2-6. The growing season deferment period for this scenario is from March 15-June 30. This period would provide time to implement protection measures before the growing season and for some growth and recovery of the range vegetation.



Note: Offered boundaries are shown. With the development of preferred boundaries, the location of proposed site headquarters was changed.

FIGURE 2-10 EXISTING ROADS, PINON CANYON PARCEL

U.S. Army, Military Traffic Management Command, Fort Carson Land Aquisition Study, Huerfano and Pinon Canyon Land Parcels, Colorado. May 1978.

TABLE 2-8

BALANCED USE/PROTECTION SCENARIO, PINON CANYON PARCEL

Summary of Available Training Land and Vehicle Use

Unit Rotation	Training Acres Available[1]	Medium Stability Acres[2]	Low Stability Acres[2]	Available Vehicle-Days[3]	Brigade Training Periods Possible[4]	Division Exercises Possible	Reserve Training Periods Possible
AB	95,792	62,148	33,647	30,243	2.8	.9	3.2
DC	73,488	69,349	4,139	28,402	2.7	.9	3.0
CB	82,980	62,891	20,089	28,371	2.7	.9	3.0
DE	72,270	59,078	13,192	25,742	2.4	.8	2.7
AE	82,133	51,245	30,888	25,440	2.4	.8	2.7

[1] Excludes rockland occupying 40% of TrG unit, all protected areas, and all very low stability areas.

[2] All range sites in the parcel are in fair-poor condition.

[3] A vehicle-day is defined as 4 hours of operational time of a wheeled vehicle and 2 hours of operational time of a tracked vehicle. This is due to the increased impact caused by tracked vehicles on soils and vegetation. A four-hour period is estimated as the average time during an exercise day in which all vehicles are being driven. The operation of tracked vehicles, therefore, consumes twice as many vehicle-days as wheeled vehicles.

[4] Computed by dividing the available vehicle-days by the vehicle-days consumed by the applicable unit training.

Road Development

In addition to stabilizing main roads, major trails, lookout points and other extremely impacted areas that become apparent as use patterns develop, minor trails and severely impacted areas would be removed from use or stabilized as required.

2.6.3 Increased Use Scenario

Training Intensity

This scenario would set the training intensity at a level 15 percent above the carrying capacity. The acreages available for training in any year range from 107,540 usable acres (43,521 hectares) in the smallest three units to 131,064 usable acres (53,041 hectares) in the largest three-unit combination. The capacity for training use ranges from 44,684 to 50,207 vehicle-days which would allow approximately 4.2 to 4.7 brigade training periods (Table 2-9). Management Unit F, consisting of 41,489 usable acres (16,791 hectares) would also be available in this scenario, and has a capacity of 16,299 vehicle-days allowing approximately 1.7 Reserve training periods.

Time of Use, Rotation and Deferment

This scenario includes a growing season training deferment for the period April 1 - June 1 as shown at Figure 2-6). This is the absolute minimum period required to afford any significant vegetative protection. In addition, it is intended that the range seeding program be concentrated at the end of the third year of use to allow two full years for plant establishment.

Boundary

Unit F is an optional unit and, if included, would be used in addition to the preferred boundary area. The unit is separated from the parcel by the Purgatoire Canyon and cannot be feasibly used in a multiple unit use rotation scheme because of limited access. The unit contains 44,969 acres (18,199 hectares), of which 8 percent is unsuitable for military use due to steepness and rock outcrops. Of the remaining acreage, 89 percent has a medium stability rating and 3 percent has a low stability rating. These acreages result in a carrying capacity of 16,299 vehicle days.

If determined to be feasible, the existing bridge across the Purgatoire at the pipeline road by Van Bremer arroyo would be upgraded for access to Unit F, and the unit used for reserve training during the summer. With deferment from use during the early part of the growing season, April 1 to June 15, the unit can accommodate 1.7 reserve training periods two consecutive years followed by two years of rest.

TABLE 2-9

INCREASED USE SCENARIO, PINON CANYON PARCEL

Summary of Available Training Land and Vehicle Use

Unit Rotation	Training Acres Available[1]	Medium Stability Acres[2]	Low Stability Acres[2]	Available Vehicle-Days[3] (+15%)[4]	Brigade Training Periods Possible[6]	Division Exercises Possible	Reserve Training Periods Possible
ABC	131,064	93,276	37,788	49,859	4.7	1.6	5.3
BCD	121,199	101,109	20,090	50,207	4.7	1.6	5.3
CDE	107,540	90,209	17,331	44,684	4.2	1.4	4.8
DEA	120,351	89,463	30,888	46,836	4.4	1.5	5.0
EAB	129,844	83,005	46,839	46,803	4.4	1.5	5.0
F[5]	41,489	40,254	1,235	16,299	5	5	1.7

[1]Excludes rockland occupying 40% of TrG unit, all protected areas, and all very low stability areas

[2]All range sites in the parcel are in fair-poor condition.

[3]A vehicle-day is defined as 4 hours of operational time of a wheeled vehicle and 2 hours of operational time of a tracked vehicle. This is due to the increased impact caused by tracked vehicles on soils and vegetation. A four-hour period is estimated as the average time during an exercise day in which all vehicles are being driven. The operation of tracked vehicles, therefore, consumes twice as many vehicle-days as wheeled vehicles.

[4]With ongoing monitoring of units used for training exercises and implementation of the proposed mitigation procedures, it is estimated that carrying capacities can be exceeded by 15%, with moderate long-term resource degradation resulting.

[5]Management Unit F is available for Reserve Training only, and can be used in two of every four years.

[6]Computed by dividing the available vehicle-days by the vehicle-days consumed by the applicable unit training.

2.6.4 Increased Protection Scenario

Training Intensity

This scenario would set the training intensity at the carrying capacity level. The acreages available for training in any year range from 72,270 usable acres (29,248 hectares) in the smallest two-unit combination to 95,792 acres (38,767 hectares) in the largest two units. The capacity for training ranges from 28,371 vehicle-days to 30,243 vehicle-days, which would allow approximately 2.4 to 2.8 brigade training periods for each combination of units (Table 2-10).

Time of Use, Rotation and Deferment

This scenario would include a growing season deferment from March 1 to August 15, as shown on Figure 2-6. This period would provide more protection during the freeze-thaw time and the majority of the growing season. Coincidentally, the March time period corresponds to sensitive times of wildlife activity.

In addition, this scenario includes total deferment of use during times of drought. Drought conditions would be analyzed on a monthly basis starting in March and continued until September. Deferment would occur when the cumulative precipitation starting in March falls below the values listed below. Use would start again when the cumulative precipitation rises above the values listed below.

Month	Cumulative Precipitation (Inches) (Centimeters)
March	0.24 (0.61)
April	0.69 (1.75)
May	1.44 (3.66)
June	1.72 (4.37)
July	3.07 (7.80)
August	3.68 (9.35)
September	3.99 (10.13)

Source: Colorado monthly temperature and precipitation summary for period 1951-1970. Colorado State Climatologist precipitation values are the 20 percent probability occurrence for Doherty Ranch.

If at the end of September the cumulative precipitation from March to September had not exceeded 3.99 inches (10.13 centimeters), total deferment would occur until such time that the above conditions are met. This deferment program is the primary difference between this scenario and the Balanced Use/Protection Scenario.

TABLE 2-10

INCREASED PROTECTION SCENARIO, PINON CANYON PARCEL

Summary of Available Training Land and Vehicle Use

Unit Rotation	Training Acres Available[1]	Medium Stability Acres[2]	Low Stability Acres[2]	Available Vehicle-Days[3]	Brigade Training Periods Possible[4]	Division Exercises Possible	Reserve Training Periods Possible
AB	95,792	62,148	33,647	30,243	2.8	.9	3.2
DC	73,488	69,349	4,139	28,402	2.7	.9	3.0
CB	82,980	62,891	20,089	28,371	2.7	.9	3.0
DE	72,270	59,078	13,192	25,742	2.4	.8	2.7
EA	82,134	51,245	30,888	25,440	2.4	.8	2.7

[1] Excludes rockland occupying 40% of TrG unit, all protected areas, and all very low stability areas

[2] All range sites in the parcel are in fair-poor condition.

[3] A vehicle-day is defined as 4 hours of operational time of a wheeled vehicle and 2 hours of operational time of a tracked vehicle. This is due to the increased impact caused by tracked vehicles on soils and vegetation. A four-hour period is estimated as the average time during an exercise day in which all vehicles are being driven. The operation of tracked vehicles, therefore, consumes twice as many vehicle-days as wheeled vehicles.

[4] Computed by dividing the available vehicle-days by the vehicle-days consumed by the applicable unit training.

Limited and Restricted Use Areas

In addition to no vehicle use of any wildlife or soil protection area, no dismounted troop use would be allowed.

Road Development

In addition to stabilizing main roads, major trails, lookout points and other extremely impacted areas that become apparent as use patterns develop, minor trails and other severely impacted areas would be removed from use or stabilized as required.

2.6.5 Comparison of Scenarios

The three scenarios are compared on Table 2-11. Between 2.4 and 4.7 brigade training periods can be accommodated according to the scenario selected; potential division exercises range between 0.8 and 1.6 and reserve training periods range between 2.7 and 5.3, not including Management Unit F, which can carry 1.7 Reserve training periods. Thus, a variety of training exercises to accommodate military training needs can be selected. As shown on Figure 2-18, the Increased Use Scenario includes training use that exceeds carrying capacities by 15 percent. The Balanced Use/Protection Scenario contains a 3-year rest period for revegetation and other mitigation measures to be applied. The Increased Protection Scenario includes a 3-year rest period plus drought deferment. The key natural resource protection measures are summarized on Figure 2-11.

2.7 COMPARISON OF IMPACTS

Impacts on each parcels from military training would vary according to the Land Use and Management Plan (LUMP) and scenario for each parcel. The following comparison of impacts addresses both the significance of impacts and the relative severity of impacts occurring between the two parcels.

2.7.1 Geology/Minerals

Military training use of either the Huerfano River Parcel or the Pinon Canyon Parcel would not impact geologic features in either Parcel (Sections 4.1.1 and 4.2.1). Impacts on the proposed Red Rocks National Natural Landmark on the Pinon Canyon Parcel are discussed in Section 2.7.9, Cultural Resources. Impacts on the proposed Colorado Natural Area on the Huerfano River Parcel are also discussed in Section 2.7.9.

The removal of land from future exploration for energy fuels/ minerals in either parcel could affect possible future use of uranium known to exist in the Morrison and Purgatoire Formations in both parcels (Colorado School of Mines Research Institute, 1980). Impacts to the

TABLE 2-11

PINON CANYON PARCEL

Comparison of Scenarios

Scenario	Balanced Use/Protection		Increased Use		Increased Protection	
	Smallest 2 Units	Largest 2 Units	Smallest 2 Units	Largest 2 Units	Smallest 2 Units	Largest 2 Units
Vehicle day use allowed yearly	25,440 (AE)	30,243 (AB)	44,684 (CDE)	50,207 (BCD)	25,440 (EA)	30,243 (AB)
Available Brigade Training Periods	2.4	2.8	4.2	4.7	0-2.4[1]	0-2.8[1]
Available Division Exercises	.8	.9	1.4	1.6	0-0.8	0-0.9
Available Reserve Training Periods	2.7	3.2	4.8[2]	5.3[2]	0-2.7	0-3.2

[1] Due to the drought deferment required in this scenario, no military exercises would be allowed in an estimated two of every ten years.

[2] With the availability of Unit F in the Increased Use Scenario, an additional 1.7 Reserve Exercises would be available two out of three years. Use on Unit F would be limited to Reserve Exercises due to size and accessibility constraints.

<table>
<tr><th colspan="2">Protection Measure</th><th>Balanced Use/ Protection</th><th>Increased Use</th><th>Increased Protection</th></tr>
<tr><td rowspan="2">Time of Use</td><td>Deferment</td><td>March 15 - June 30
Dec. 15 - Jan. 15
Wet Soil Deferment</td><td>April 1 - June 1
Dec. 15 - Jan. 15
Wet Soil Deferment</td><td>March 1 - August 15
Dec. 15 - Jan. 15
Drought Deferment
Wet Soil Deferment</td></tr>
<tr><td>Rotation</td><td>2 unit use, 3 year rest</td><td>3 unit use, 2 year rest</td><td>2 unit use, 3 year rest</td></tr>
<tr><td rowspan="3">Road Devel- opment</td><td>Main Roads</td><td colspan="3">Develop all boundaries as roads around units.</td></tr>
<tr><td>Main Trails</td><td colspan="3">Upgrade surfaces of well-traveled areas. (Trails, roads and lookout points.)</td></tr>
<tr><td>Minor Trails</td><td>Upgrade surfaces as needed</td><td>No action</td><td>Upgrade surfaces as needed</td></tr>
<tr><td colspan="2">Purgatoire River Crossings</td><td>Not Applicable</td><td>Upgrade bridge to reach Unit F if feasible</td><td>Not Applicable</td></tr>
<tr><td rowspan="3">Limited Use Areas</td><td>Wildlife Protection Areas</td><td colspan="3">No Military Use.</td></tr>
<tr><td>Transpor- tation Corridor</td><td colspan="3">Develop roads within corridor to assure access to all units; mark soil protection areas and radio tower as off limits.</td></tr>
<tr><td>Soil and Endangered Plant Protection Areas</td><td colspan="3">Includes all large units of Shaly Plains--all vehicular access restricted.</td></tr>
<tr><td colspan="2">Training Intensities</td><td>Use not to exceed carrying capacities.</td><td>Use not to exceed carrying capacities plus 15%.</td><td>Use not to exceed carrying capacities.</td></tr>
</table>

FIGURE 2-11

COMPARISON OF KEY NATURAL RESOURCE PROTECTION MEASURES

PINON CANYON PARCEL

mineral resources of each parcel differ only in the withdrawal of land from limestone development in the Huerfano River Parcel. Although data are not available to quantify the impact of removal of the limestone from development, the predicted impact would probably be severe, according to information received from the Colorado Board of Land Commissioners. Other impacts for the two parcels are essentially equal.

2.7.2 Soils

The training intensities that would occur on the Huerfano River and Pinon Canyon parcels were developed from land stability and the acreage available annually for training use. Because intensities are determined on an acre-by-acre basis, the average impacts on each acre for either parcel would theoretically be the same. The variation in natural conditions on each parcel, however, will influence the response and recovery of each land area to impacts and result in differences in impact response for each parcel.

Water erosion losses of soil would be significantly higher on the Pinon Canyon Parcel than on the Huerfano River Parcel with training use. Portions of upper drainages in the Pinon Canyon Parcel presently exhibit some head-cutting and gully formation and would require swift mitigation of impacts to prevent further deterioration. River fording would impact moist soils adjacent to the water in the Huerfano River parcel and would not occur on the Pinon Canyon parcel.

The land area susceptible to wind erosion losses is somewhat greater on the Huerfano River Parcel than on the Pinon Canyon Parcel. Although portions of the landscape that would be exposed to wind erosion by training use can only be approximated, it can be expected that land treatment necessary to prevent fugitive dust would be higher on the Huerfano River parcel.

In the Balanced Use/Protection and Increased Use scenarios, more land would experience a negligible and slight impact in the Huerfano River Parcel than in the Pinon Canyon Parcel (Table 2-12). This is due to the area set aside for wildlife protection along the Cucharas and Huerfano Rivers. In the Increased Protection Scenario, the removal of the northernmost portion of the Huerfano River Parcel (Unit A) from use would result in an even higher portion of land experiencing negligible or slight impacts. Because grazing would be limited on either parcel, the lands experiencing negligible or slight impacts from training use would gradually improve from the present condition, increasing the vegetative cover and resulting in increased protection of the soil surface.

2.7.3 Vegetation

Impacts of military training use on the vegetation of the Pinon Canyon and Huerfano River Parcels would be basically the same. Table 4-3

TABLE 2-12

COMPARISON OF LAND AREA IMPACTS

HUERFANO RIVER AND PINON CANYON PARCELS

Scenario	Level of Impact (percent)				
	Negligible	Slight	Moderate	Severe	Extreme
Increased Protection					
Huerfano River	35	19	19	19	8
Pinon Canyon	18	24	24	24	10
Balanced Use/ Protection					
Huerfano River	21	17	22	31	9
Pinon Canyon	13	19	24	34	10
Increased Use					
Huerfano River	17	13	22	35	13
Pinon Canyon	8	15	24	39	14
(With Unit F)	8	15	24	39	14

applies to both parcels with respect to impacts on the vegetation insofar as percentages of land impacted in Management Units is concerned.

Overall range site stability is higher on the Huerfano River Parcel than on the Pinon Canyon Parcel. Comparisons of the two parcels from the viewpoint of range site stability places the Huerfano River an estimated 28 percent greater in its range site stability than the Pinon Canyon Parcel (Table 2-13).

TABLE 2-13

PERCENTAGES OF LAND IN
RANGE SITE STABILITY CLASSES

Range Site Stability	Huerfano River Parcel	Pinon Canyon Parcel
Medium	81.4	64.6
Low	15.9	30.6
Very Low	2.7	4.8

The establishment and maintenance of vegetation on and around the cantonment at Cedarwood for the Huerfano River Parcel would be more favorable than the Thatcher site for the Pinon Canyon Parcel. This comparison is based on vegetation that indicates that Cedarwood receives more precipitation than Thatcher.

The vegetation in riparian or meadow plant communities will be more threatened on the Huerfano River Parcel than on the Pinon Canyon Parcel, because no river crossings are proposed for the Purgatoire River and crossings would be made on the Huerfano River.

2.7.4 Hydrology

Surface Water Hydrology

Potential impacts to surface water quality in both the Huerfano River and Pinon Canyon Parcels would be similar. However, the potential for increased sedimentation in the Pinon Canyon Parcel would be slightly greater than that in the Huerfano River Parcel. This is due primarily to the inherent erodibility characteristics of the soil types, the respective percentages of each soil type, and the effects of channelization on sediment delivery in the parcel. Potentially increased salinity levels are similarly anticipated.

Larger runoff and sediment control structures would be needed on the main-stem Huerfano River and for the existing irrigation ditches in that parcel as compared to similar structures constructed in the Pinon Canyon Parcel. Protective structures for the irrigation ditches in the Huerfano River Parcel would be required to protect the surface water quality of irrigation water supplies diverted from within the parcel for downstream users. A greater number of these structures may be necessary in the Pinon Canyon Parcel. Detailed engineering studies would be required for comparative economic evaluation.

The water supply issue for either parcel is presently unresolved. Therefore, no comparison for the parcels is possible at this time; further studies would be necessary to identify a water supply.

Ground Water

Potable water supplies might be derived from surface sources piped from Trinidad for Pinon Canyon or from ground water sources. Huerfano River Parcel would derive its potable water supplies from ground water. Impacts, as they relate to ground water, will depend upon site specific aquifer characteristics which at this time are not known. Ground water withdrawals from either parcel could cause a moderate to severe decline in water levels over a large area, specifically in the vicinity of a well field required to meet the cantonment water requirement of 440 gpm (28 l/s). A decrease in head within the developed aquifer could result in migration of poor quality water from other aquifers in hydraulic connection and a resultant decrease in water quality.

The source of a potable water supply for the cantonment area at either parcel is an unresolved issue at this time. Data indicate that water requirements for field maneuver training could probably be supplied by ground water.

2.7.5 Wildlife

Terrestrial Ecology

Wildlife habitats and population on the two parcels are very similar (see Appendix F). However, the Pinon Canyon Parcel has one additional species present, the Turkey. Additionally, there is potential for Bighorn Sheep and Peregrine Falcons being introduced to Purgatoire Canyon, and Scaled Quail population levels on the Pinon Canyon Parcel are somewhat higher. Therefore, it appears that wildlife populations would be more severely impacted if the Pinon Canyon Parcel were to be selected.

Aquatic Ecology

Both the Huerfano River and the Pinon Canyon Parcel water bodies could experience the same type of impacts, including increases in turbidity, salinity, total dissolved solids and total suspended solids through increases in soil and wind erosion. The magnitude of the impacts is anticipated to be insignificant if all mitigation measures described in the LUMPs are implemented.

Compared to the Huerfano River, the Purgatoire River is better protected by steep canyon walls throughout its run in the Pinon Canyon Parcel, with more well defined drainage areas from the upland portion of the parcel (which affords easier implementation of mitigation measures). In addition, there will be no water crossings of the Purgatoire River. The Pinon Canyon Parcel probably would experience less impact than the Huerfano River Parcel as far as aquatic resources are concerned.

2.7.6 Air Quality

Impacts on air quality and the Colorado ambient air standards would be almost exactly the same for both parcels. Impact on the annual particulate standard for both parcels would be slight to moderate outside the respective parcels. Inside both parcels, within the actively used Management Units, the annual particulate standard is expected to be exceeded by about 5 $\mu g/m^3$. This would require restricting public access to the Management Units in use during training. In the worst-case analysis, both parcels would have exceedances of the 24-hour standard within 500 meters of the main road leading out of the cantonment area to the training units (or any other road expecting to have a similar traffic volume). Mitigation of this impact would be possible by not locating such a road within 500 meters of a property boundary or by paving sections that were within 500 meters of the boundary. Only wheeled vehicles would use the paved sections and another parallel graveled road would be established for tracked vehicles. Both parcels would experience a negligible impact on ambient levels of any existing standard for carbon monoxide, nitrogen oxides, and sulfur dioxide.

Although particulate generation from both parcels is similar, the Huerfano River Parcel differs from the Pinon Canyon Parcel in that the northernmost point of Huerfano River Parcel is located relatively close (6 miles) (9.7 kilometers) to the city of Pueblo, which is rated as nonattainment for particulates. Consequently, because of existing conditions, the level of particulates is a potentially significant impact to Pueblo. While the results of the dispersion modeling estimate the incremental concentration at downtown Pueblo to be 1.5 $\mu g/m^3$, just 0.5 $\mu g/m^3$ above the level of insignificance, this estimate is considered to be too high because of the inability of the model to correctly compute wind erosion emissions and deposition of particulates.

In summary, from an air quality perspective, both parcels are about equal. Huerfano River Parcel impacts are slightly more serious because of the proximity to the city of Pueblo.

2.7.7 Sound

The overall noise impact at the Pinon Canyon Parcel will be less than at the Huerfano River Parcel because the surrounding region is less densely populated. The noise sources would be the same but fewer people would be affected.

Principal sources of noise would be vehicle maneuvers, simulation of artillery and tank fire, jet aircraft, and helicopters. In addition, the convoy of wheeled vehicles to and from Fort Carson will affect areas along the route to the parcel. The passage of a convoy would cause moderate impacts up to 1/2 mile (0.8 km) from the highways during daytime and severe impacts during the night at these locations. The impact would be higher for highways which carry little traffic and less for heavily travelled highways.

Transportation of tracked vehicles from Fort Carson to the site by rail would result in negligible impact along the route for either site. Helicopters in transit to the parcel would cause slight impacts, especially at the Huerfano River Parcel, and the impact of jet aircraft in transit from Buckley Air Force Base would be negligible.

The noise impact of all activities, including the convoy, would be more severe if the activity occurs at night. Training activities which produce the most noise should take place as far from populated areas as permitted by the LUMP scenario. To mitigate noise from aircraft, the altitude of both helicopters and jet aircraft should be as high as practical when proceeding to and from the parcel. Flight paths should be selected to minimize travel over populated or noise sensitive areas.

The mitigating measures for training activity at Pinon Canyon Parcel are the same as those for Huerfano River Parcel. In addition, a proposed link between Interstate 87 and Interstate 350 bypassing the town of Trinidad would lessen the impact of convoys.

2.7.8 Socioeconomics and Land Use

The population/demographics impacts are the same for both parcels since both are very sparsely populated areas, though an estimated seven more persons live on the Pinon Canyon Parcel. The economic impacts are also similar for each parcel with the following exceptions. The acquisition of the Huerfano River Parcel would remove a slightly higher number of cattle from grazing production due to the lower carrying capacity of the Pinon Canyon Parcel. The impact of grazing cessation would be slightly greater at the Pinon site, however, due to the primarily agriculture-based economy there. The more diversified industrial economy in Pueblo County would reduce the impact of loss of a portion of the local cattle industry.

The problems with losses in tax revenues are greater for the Pinon Canyon Parcel due to the generally smaller amounts of revenues available to Las Animas County. Industry and much higher population densities in Pueblo County generate much more money for the Pueblo County General Fund and School Districts. The worst of the tax associated impacts is the reduction in value of mills in Hoehne School District, which would lose over a quarter of the tax base if the Pinon Canyon Parcel were acquired.

Transportation impacts differ primarily in the additional fuel consumption which would be required to reach the Pinon Canyon Parcel. It is located 90 miles further from Fort Carson and would require over twice as much fuel to travel to and from the site. About 50 additional miles of use of Interstate 25 would be required to reach the Pinon Canyon Parcel, but this is not anticipated to create any problems with traffic flows. Extra fuel would also be required for the two trains of tracked vehicles which would be needed for each brigade maneuver. Fuel consumption at the sites would not be expected to differ greatly between the two parcels.

One additional impact is the fact that air access to the Huerfano parcel lies within the Terminal Control Area for the town of Pueblo. This would potentially create more work for air traffic controllers to vector military or civilian aircraft through airspace on days of potential conflict. No such problem would be created at the Pinon Canyon Parcel.

2.7.9 Cultural Resources

The cultural resources of both parcels are practically identical. There is evidence of early Indian use of both the canyons and uplands and a 100 percent survey would be conducted for either site. Recent historical activity consists of scouting parties, explorers and a stage line serving both areas, none of which is expected to present a barrier to selection of either parcel. The scenic area of the Pinon Canyon Parcel under consideration for National Natural Landmark designation, as discussed in Section 4.2.8, would constitute an extreme impact upon military use if so designated. The Huerfano and Cucharas Canyon areas on the Huerfano River Parcel have been proposed for designation as a State Natural Area. However, the proposed boundaries for this natural area coincide closely with the boundaries which have been included in the non-use wildlife protection area and thus would not conflict with military use if so designated. Impacts are therefore more severe for the Pinon Canyon Parcel.

2.8 PRELIMINARY CONCLUSIONS BASED ON LUMPs

The acquisition of either the Huerfano River or Pinon Canyon Parcels was tentatively determined to be a feasible course of action to resolve the shortfall of maneuver training land based on an initial evaluation of general technical, economic and environmental conditions. The detailed, three-scenario, Land Use and Management Plans and the associated impacts developed in this document enable some preliminary conclusions to be drawn. Interested persons or agencies can therefore focus their review and evaluation, and subsequent comments, on the most specific, preferred course of action that can presently be identified. Preliminary conclusions are as follows:

1) The Huerfano River and Pinon Canyon sites are both feasible courses of action for resolving the maneuver training shortfall. Although advantages and disadvantages are associated with each site, their capabilities for training and the potential environmental impacts are so similar that a preferred site cannot be identified at this time. The review of this document and subsequent public and agency input should play a major role in the eventual selection of a preferred site.

2) The Increased Use Scenario LUMP, with some modification to provide additional mitigation, is identified as the preferred course of action for both parcels. The selection of this scenario is based on the level of training provided and the projected potential environmental impacts. Project reviewers should focus on this preferred course of action.

a) Natural Resource Conservation Measures - All of the measures included in the list of actions to precede training use and to continue as ongoing programs would be performed as integral elements for either site (Section 2.4.4).

b) Training Intensity - The training levels shown on Tables 2-4 and 2-9 are the main factor in selection of the Increased Use Scenario. They will provide for one training period annually for each of the three brigades in the division with the remaining brigade training period(s) available for reserve unit training. The lower training levels provided in the other scenarios are not preferred because the benefits become borderline when compared to the costs of acquisition, development and environmental management.

c) Time of Use - Rotation and Deferment - The rotation plans for the Increased Use Scenario shown on Figures 2-5 and 2-9 would be implemented. It should be noted that the actual combination of management units could be modified from that shown on the figures but that the 3-unit, 3-year use - 2-year rest rotation would be followed.

The scheduled deferment periods shown on Figures 2-5 and 2-9 would be modified to include growing season deferment during the month of June. This additional protection for vegetation would be of significant benefit to the environmental management program. The months of July and August would be available to conduct reserve unit training.

The unscheduled wet soil training deferment program described on page 2-16 would be implemented at either site.

d) Boundary - The preferred boundary for the sites is as shown on Figures 2-4 and 2-8, with the notable exception of the extended area, or "tail," of the Huerfano River Canyon and the entire Purgatoire River Canyon. As discussed on pages 2-21 and 2-33, respectively, these areas are not required for military training. They are displayed and discussed as potential wildlife management areas, because individuals and agencies indicated that the best and highest use would result from their retention as natural areas. Also, it should be clear that due to land acquisition procedures the government may be required to buy the "tail" of the Huerfano River Canyon and portions of the Purgatoire Canyon, see Section 2.5.

Management Unit F at the Pinon Canyon site would substantially increase the available training for that site. However, it is not preferred at this time because of the disadvantages associated with its location across the Purgatoire River. If any major modifications in the preferred boundary become necessary as this decision process proceeds, the status of Unit F might change.

e) Limited and Restricted Use Areas - The soil protection areas identified for either site would be established.

The portion of the Huerfano River Canyon within the main body of the site and the Cucharas River would be established as a wildlife protection area and would also be considered for designation as a State Natural Area. If the "tail" of the river canyon is obtained and retained by the government, the Department of the Army would recommend that it be similarly managed.

If any portion of the Purgatoire River Canyon is obtained and retained by the government, the Department of the Army would recommend that it be managed as a natural wildlife protection area.

f) Cantonment Area, Road Development and River Crossings - The cantonment facility, roads and river crossings would be developed as discussed in Section 2.5.1 and 2.6.1 and as shown on Figures 2-7 and 2-11.

It should be clearly understood by all reviewers that the preliminary conclusions presented above do not represent final decisions. They are proposals for consideration within the decision process prescribed by the National Environmental Policy Act and may be modified as a result of public and agency comment.

3.0 AFFECTED ENVIRONMENT

3.1 HUERFANO RIVER PARCEL

The affected environment description of the Huerfano River Parcel includes the existing environmental characteristics of the parcel. The following summaries of baseline conditions are supplemented by more detailed data in the Appendices.

3.1.1 Geology/Mineral Resources

Topography and Physiography

The Huerfano River Parcel lies at the margin between the Colorado Piedmont and Raton Sections of the Great Plains Physiographic Province. The northern edge of the Raton Section is characterized by higher altitudes and deep canyons, with well-developed cliffs along major rivers while the Colorado Piedmont exhibits more moderate topography. In general, the areas less than 5000 feet (1524 m) mean sea level (msl) in the parcel exhibit steep topography and deep canyons characteristic of the Raton Section while those above that altitude are Piedmont in nature.

Topography is varied, rising from north to south. The highest point, near the southern edge of the parcel, is at an elevation of nearly 6000 feet (1829 m) above mean sea level (msl). The lowest elevation lies in the eastern portion near Mustang Creek at an elevation of approximately 4700 feet (1433 m) msl. Elevations along the northern boundary range from 4700 feet (1433 m) to nearly 5000 feet (1524 m) msl and rise southward to an average of 5800 feet (1768 m) msl along the bluffs above the river valleys.

Drainage is controlled by a southwest to northwest slope gradient ranging from 50 to 100 feet per mile (9 to 19 m/km). The parcel is crossed by the Huerfano River, which drains much of the western two-thirds of the parcel before joining the Arkansas River 18 miles (29 km) east of Pueblo. A divide occurs immediately east of Doyle Arroyo, and the eastern one-third of the parcel is drained by small tributaries of the Arkansas River and the Apishapa River to the east and northeast.

Geology

The Huerfano River Parcel lies on the Apishapa Uplift, a gentle positive structure which separates the Raton Basin to the southwest from the Denver-Julesburg Basin which lies to the northeast. The parcel is underlain by a relatively thin cover of sedimentary rocks overlying the Precambrian basement. A more complete discussion of the subsurface geology is included in Section 3.1.4.

Bedrock units outcropping at the surface range from the Upper Cretaceous Pierre Shale Formation in the northern portion to the Jurassic

Morrison Formation along deeper river canyons in the southern section. Along the lower reaches of the river valleys, the bedrock units are overlain by Quaternary alluvial deposits. Of the geologic units outcropping in the area, the unconsolidated deposits and the softer sedimentary rocks such as the Pierre Shale and the Niobrara Formation are easily eroded. The dominant units of the area are the Niobrara Formation, the Benton Group, and the Dakota Sandstone. Units of minor importance are alluvial deposits, Pierre Shale, Purgatoire Formation, and Morrison Formation.

The Niobrara Formation crops out in a northwest to southeast trend across the northern one-half of the parcel. The Benton Group has been subdivided into three formations: the Carlile Shale, Greenhorn Limestone, and Graneros Shale. This group covers much of the area surrounding the higher mesas in the central and southern area. The Dakota Sandstone caps the mesas of the parcel; the Pierre Shale crops out in a small area in the extreme northern portion of the parcel. The Purgatoire and Morrison Formations are found only in the deeper canyons of the Huerfano River and canyons in the southeast portion of the parcel.

The geologic structure of the area is dominated by the Apishapa Uplift which trends southeast to northwest across the central portion of the Huerfano River Parcel. The southeast and northwest plunging uplift brought the Dakota Sandstone to the surface. The sedimentary rocks dip gently to the northeast and southwest away from the arch. Geologic faulting is present in Doyle Arroyo and across the southern boundary of the parcel. Some small folds are also present near Haystack Butte in the southeast corner.

Geologic Hazards

Several landslide deposits have been mapped along the Huerfano River in the west-central portion of the parcel (Colton, 1975). The oversteepened topography caused by river erosion has resulted in unstable slopes and subsequent landslides.

Erosion represents a major geologic hazard in the northern one-half of the study area because the rock units in this area are weak and the overlying soils are thin and poorly developed. The stronger bedrock formations in the southern portion of the site are much less susceptible to erosion.

The Huerfano River Parcel is located in Seismic Risk Zone I. Only minor damage is expected from earthquakes in this zone. Earthquake hazard/seismicity are discussed in Appendix B.

Mineral Resources

Based on the evaluation of the mineral and energy resource potential of the Huerfano River Parcel, Colorado School of Mines Research Institute

(1980) concluded that "With the possible exception of uranium, no potentially economic deposits of leasable, locatable, or saleable minerals or fuels are known to exist on or in close proximity to the Huerfano River Parcel." No exploration activity for uranium or minerals other than limestone was noted in the Huerfano River Parcel area. Exploration is underway, however, on a limestone deposit in the northwest corner of the parcel. At present, 3,912 acres (1,583 hectares) are under lease and some drilling has been done on the property (Rogers, 1980). The areas under lease are listed on Table 3-1 and shown on Figure 3-1. Data concerning the limestone deposits are proprietary; therefore no value can be presently determined. However, the State Board of Land Commissioners has indicated an interest in the possible development of these limestone deposits (Rogers, 1980). Appendix B gives a detailed account of mineral resources of the Huerfano River Parcel.

3.1.2 Soils

The soils of the Huerfano River parcel were mapped as soil-range mapping units, delineating discrete land areas in which soils and plant growth conditions are similar. Names of the units reflect the range site or complex of range sites on the landscape. Wherever a range site occurs it will have similar soils and proportions of plant species. Maps of the management units are included in Appendix A. Detailed descriptions of each mapping unit and range site components are included in Appendices C and D.

Within the Huerfano River Parcel, three major landscape types occur as shown on Figure 3-2. Each landscape type has soil-range mapping units common to it as briefly described below. The first landscape type, found on the north and northeast part of the parcel, is predominated by a flat to gently sloping plain. The soils occurring in this position are formed in wind-deposited silts, with some areas where limestone occurs within 40 inches (102 cm) of the surface. They are silty, weakly developed soils that are calcareous throughout. The soil-range mapping units dominating this landscape are LP (Loamy Plains) on the upland flats and SO (Saline Overflow) in depressions and along intermittent drainages. This landscape type generally has a medium stability rating (see Section 2 for an explanation of stability ratings) and would experience moderate soil losses by water erosion and high soil losses by wind erosion if disturbed.

The second major landscape type crosses the parcel diagonally in a northwest to southeast trend. This type is characterized by rolling limestone ridges covered with scattered Pinyon and Juniper trees away from the river and steep cliffs and hillslopes facing the river. Soils are commonly silty with limestone at 30 in (76 cm) or more in gently rolling grassy areas and stone covered and silty soils with limestone at 20 in (50 cm) or less in areas supporting stands of Pinyon pines and One-seed Junipers. Rock outcrops of limestone and shale occur on cliff faces, and weathered shale occurs at the base of cliffs and ridges. The soils in this landscape type are generally all weakly

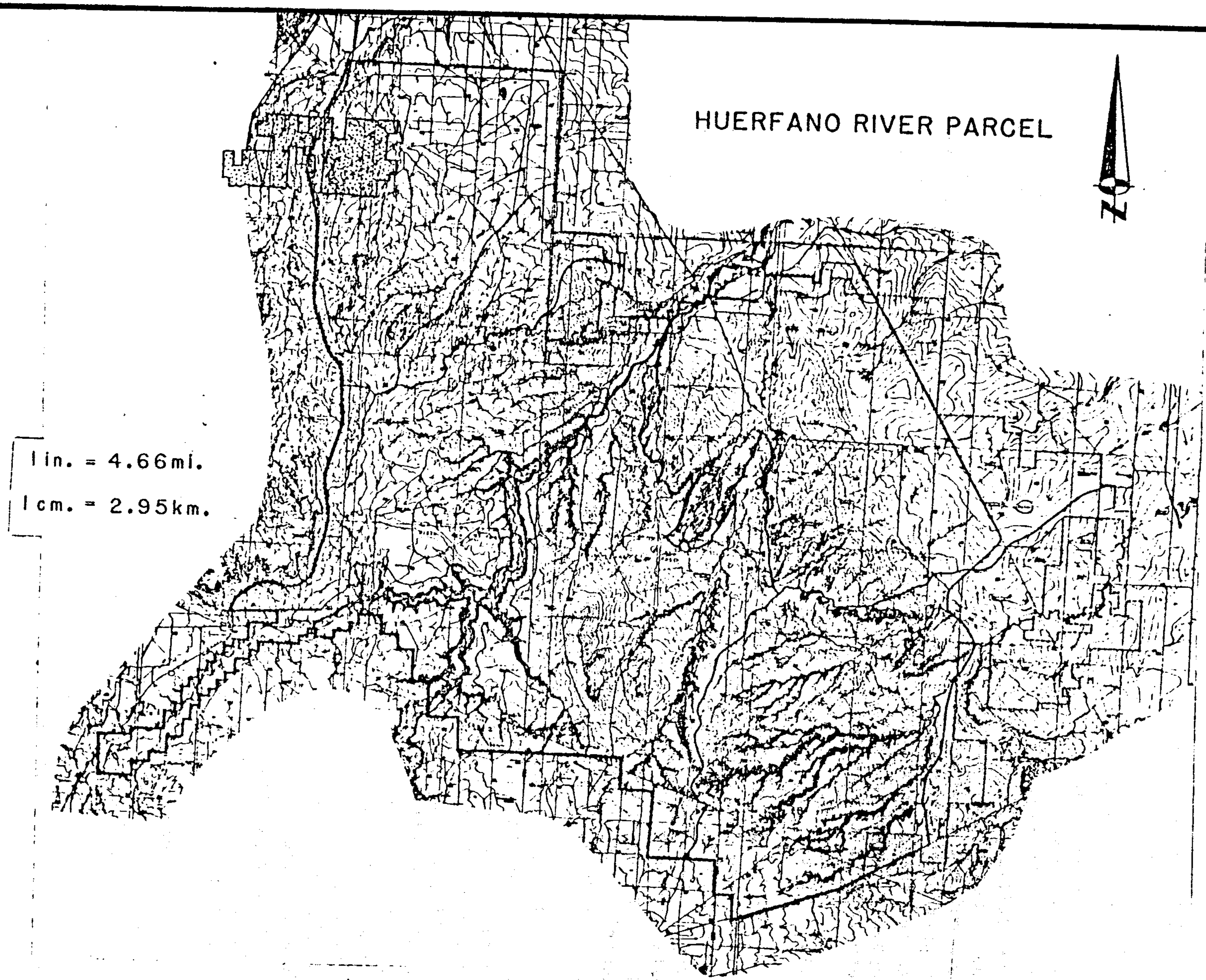


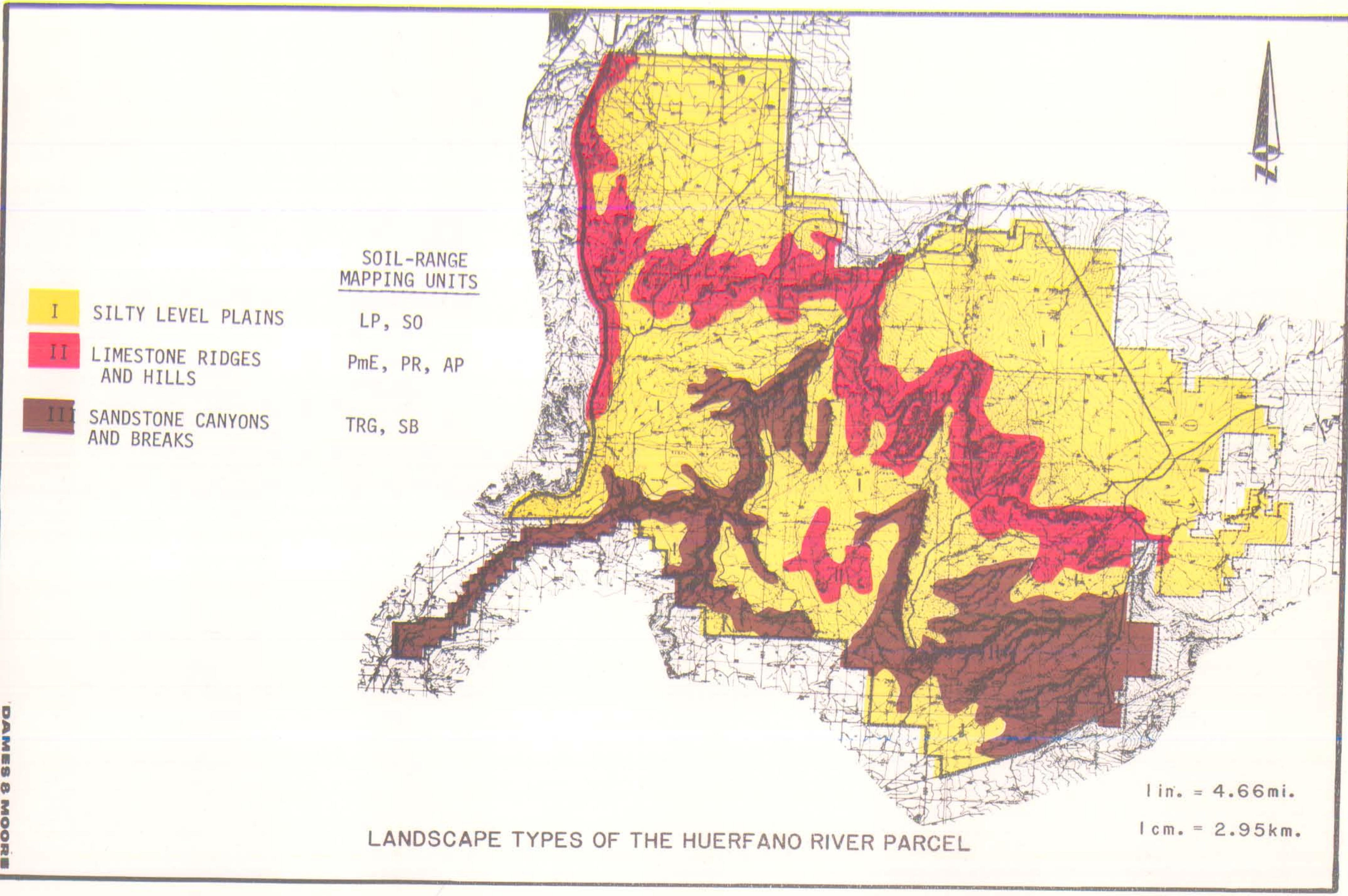
FIGURE 3-1 LAND LEASED FOR LIMESTONE EXPLORATION

TABLE 3-1

LAND UNDER LEASE FOR LIMESTONE EXPLORATION, IN AND ADJACENT TO THE NORTHWEST CORNER, HUERFANO RIVER PARCEL[a]

Acres	Subdivision	Section Township Range
515.80	NE/4NE/4; W/2E/2; W/2	19 22S 64W
436.20	NE/4NE/4; W/2NE/4; W/2	30 22S 64W
400.00	NE/4; E/2NW/4; SW/4NW/4; N/2SE/4; SW/4SE/4	22 22S 65W
480.00	NE/4; S/2	24 22S 65W
640.00	All	25 22S 65W
480.00	W/2E/2; W/2	27 22S 65W
600.00	E/2; NW/4; N/2SW/4; SE/4SW/4	28 22S 65W
360.00	Aded by B.O. #7358 dated 10/22/79 N/2NE/4; SW/4NE/4; NE/4SW/4; W/2SE/4 Sec. 23 and W/2NE/4; NE/4NW/4 Sec. 26	22S 65W
3,912.00		

[a]Personal Communication, Rowena Rogers, President, Colorado Board of Land Commissioners, to Lt. Col. Don Safford and Mr. Michael Halla, Dept. of the Army, March 5, 1980.



LANDSCAPE TYPES OF THE HUERFANO RIVER PARCEL

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developed silty soils which are calcareous to the surface and contain low amounts of organic matter. The soil-range mapping units commonly occurring in this landscape type are PmE (Limestone Breaks-Loamy Plains Complex), PR (Limestone Breaks-Pinyon Juniper Complex), AP (Alkaline Plains) and some small areas of SP (Shaly Plains). The landscape type generally has a low stability rating and will experience high soil losses by water erosion and moderate soil losses by wind erosion if disturbed.

The third major landscape type, occurring along major drainageways in the parcel, is characterized by steep canyons with associated moderately sloping ridges and hills. Soils on the slopes are underlain by hard sandstone, with many areas of boulders, stones and gravel fragments being found throughout. These areas support dense stands of Pinyon pines, One-seed Junipers and scattered Ponderosa pines. The soils range from deep, medium-textured soils on mesa tops to bouldery and stony soils below sandstone cliffs. The soils are generally non-calcareous at the surface with moderate amounts of organic matter in surface layers, and range in soil development from moderately developed soils in gently sloping areas to weakly developed soils in steep areas. Mapping units found in this landscape type are SB (Sandstone Breaks), TrG (Pinyon Juniper-Rockland Complex) with some areas of LP (Loamy Plains) along mesa tops. The soils occurring directly adjacent to the Huerfano and Cucharas Rivers in the canyon bottoms are SM (Salt Meadows) and SO (Saline Overflow) units. This landscape type generally has a medium stability rating in gently sloping areas and a low stability rating in moderately steep and steep areas. Gently sloping areas would experience moderate water erosion losses and steeper areas would experience high to very high water erosion losses if disturbed. Wind erosion losses on these soils will be low if disturbed.

The nine soil-range mapping units identified on the parcel are listed in Table 3-2.

TABLE 3-2

SOIL-RANGE MAPPING UNITS OF THE HUERFANO RIVER PARCEL

Mapping Unit Symbol	Range Site Components
LP	Loamy Plains
SB	Sandstone Breaks
PR	Limestone Breaks - Pinyon-Juniper Complex
PmE	Limestone Breaks - Loamy Plains Complex
SO	Saline Overflow
TrG	Pinyon-Juniper - Rockland Complex
AP	Alkaline Plains
SP	Shaly Plains
SM	Salt Meadow

Table 3-3 summarizes the soil and vegetation characteristics of each mapping unit described on the Huerfano River Parcel. Detailed

TABLE 3-3

SOILS AND VEGETATION SUMMARY FOR THE HUERFANO RIVER PARCEL

(Preferred Boundary)

SOIL RANGE UNIT & RANGE SITE	ACRES (Hectares)	PERCENT OF PARCEL	SOILS AND PHYSIOGRAPHY	PERCENT PERENNIAL PLANT COVER Potential	PERCENT PERENNIAL PLANT COVER '79 Transects	MAJOR NATIVE PLANTS OF POTENTIAL PLANT COMMUNITY	TOTAL ANNUAL PLANT YIELD-Pounds/Acre (Kilos/Hectare) Potential	TOTAL ANNUAL PLANT YIELD-Pounds/Acre (Kilos/Hectare) '79 Estimate	PRESENT CONDITION AND STABILITY
LP Loamy Plains	128,617 (52,051)	57.2	Deep and moderately deep medium-textured silty soils that are commonly calcareous to the surface, on broad gently sloping plains and mesas.	20	11.4 to 13.4	Blue grama dominates. Grows in association with galleta, ring muhly, red three-awn, squirrel-tail, cholla, prickly-pear, snakeweed, winterfat and other drought-enduring plants.	200-1500 (220-1680)	1250 (1400)	Fair Medium
SB Sandstone Breaks	28,271 (11,441)	12.6	Moderately deep and shallow medium-textured stony soils that are noncalcareous with scattered areas of sandstone rock outcrops, on ridge tops and transitional areas between mesas and canyons.	30	10.8 to 14.6	Blue grama, side-oats, grama, needle-and-thread little blue-stem, mountain-mahogany, skunkbush, scattered juniper and pinyon.	400-2400 (450-2690)	1400 (1570)	Fair Medium
SO Saline Overflow	10,458 (4,232)	4.6	Deep medium-textured alluvial soils that are commonly calcareous and moderately alkaline, in swales and depressions along drainage-ways. These areas receive water from adjacent areas in addition to rainfall.	50	4.6 to 12.1	Western wheatgrass dominates. It is associated with alkali sacaton, galleta, vine mesquite grass, and 4-wing saltbush.	700-2500 (780-2800)	1300 (1460)	Poor Medium
SM Salt Meadow	483 (195)	0.2	Deep medium-and coarse-textured alluvial soils that are commonly calcareous, on major river bottoms. A water table occurs commonly between 4 and 6 feet.	50	2.6 to 4.2	Alkali sacaton, switchgrass, saltgrass, western wheat-grass, and foxtail barley. Cottonwood, willow, box-elder often border the site	1000-3000 (1120-3360)	1200 (1340)	Poor Medium
PME Limestone Breaks & Loamy Plains Complex	12,078 (4,888)	5.4	Shallow and moderately deep medium-textured soils weathered from limestone that are calcareous to the surface. Scattered limestone fragments on shallow soils occupy 60%, moderately deep soils with silty surface occupy 40%. On small ridges and transitional areas.	25	12.2 to 12.4	Bigelow sage, cholla, 4-wing saltbush, snakeweed, winterfat, yucca, side-oats grama, New Mexico feathergrass, blue grama, galleta and little bluestem. (See LP for Loamy Plains.)	200-1200 (220-1345)	1300 (1460)	Fair Low

TABLE 3-3 (Concluded)

SOIL RANGE UNIT & RANGE SITE	ACRES (Hectares)	PERCENT OF PARCEL	SOILS AND PHYSIOGRAPHY	PERCENT PERENNIAL PLANT COVER Potential	'79 Transects	MAJOR NATIVE PLANTS OF POTENTIAL PLANT COMMUNITY	TOTAL ANNUAL PLANT YIELD- Pounds/Acre (Kilos/Hectare) Potential	'79 Estimate	PRESENT CONDITION AND STABILITY
PR Limestone Breaks & Pinyon-Juniper	21,247 (8,599)	9.4	Shallow and medium-textured soils forming on limestone that are calcareous to the surface. Scattered limestone fragments on shallow soils occupy 50%, stony and rocky shallow soils occupy 30%. and rock outcrops of limestone and shale occupy 20%.	20		See PME for Limestone Breaks portion. One seed Juniper and Pinyon form a canopy of 10% or more in association with many species found in Sandstone and Limestone Breaks.			Fair Low
AP Alkaline Plains	11,598 (4,694)	5.2	Moderately deep and deep fine-textured soils weathered from shale that are calcareous and moderately alkaline, on toe-slopes below limestone ridges and along drainages.	25	6.2 to 11.4	Alkali sacaton, blue grama, galleta, western wheatgrass, 4-wing saltbush, cholla, Fremont goldenweed and Frankenia.	500-2000 (560-2240)	900 (1010)	Poor Low
SP Shaly Plains	1,888 (764)	0.8	Shallow fine-textured soils forming on calcareous and alkaline shale that is exposed below limestone ridges	25		Alkali sacaton, blue grama, galleta, winterfat, 4-wing saltbush, cholla, snakeweed and Fremont goldenweed form a sparse cover.	300-900 (340-1010)		Poor Very Low
TrG Pinyon-Juniper & Rockland	10,336 (4,183)	4.6	Stony moderately deep and shallow soils formed in sandstone colluvium that are noncalcareous, on canyon walls and sideslopes, occupying 60% of the unit. Cliffs and boulder rock outcroppings occupy 40%.			(See PR above for Pinyon-Juniper)			Fair Medium

Source: U.S. Soil Conservation Service Soil Survey Pueblo Area, Colorado, 1979, and Field studies of soils and vegetation, November 1979.

descriptions of mapping units and the range site component percentages of each are contained in Appendix C.

Soil Erodibility Characteristics

General

The erodibility characteristics of each mapping unit in the parcel were evaluated in order to fully understand the baseline soil erosion conditions within the parcel. Several representative plots were chosen within each mapping unit to identify the conditions of soil surface texture, aggregation, effective cover, and soil permeability which are important for developing soil erosion susceptibility factors. Appendix C details the methodology used and results of the study. Results are summarized below.

About 83 percent of the soils of the parcel are weakly developed soils with thin surface layers and no other diagnostic soil horizons. This indicates that climatic conditions are restrictive for soil development (Personal communication, G. Bowman, SCS State Soil Correlator, April 28, 1980) and that surfaces are relatively young geologically (Personal communication, R. Madole, U.S. Geological Survey, February 26, 1980).

The soil surfaces of the parcel have three major characteristics protecting the soil from erosion. The most effective is a dense scattered cover of rock fragments, especially when found in combination with shrubs and evergreen trees. The second type of surface protection includes all other types of vegetative cover, with the most effective being scattered clumps of blue grama sod. These clumps slow ground level wind speeds, catch topsoil moved from adjacent bareground areas and reduce the velocities of runoff water. The third type of surface protection is the surface crust found in bare areas which holds fine soil particles together and resists wind erosion forces (Eckert et al, 1978).

Water Erosion

The majority of the parcel has moderate amounts of soil that is being moved annually by water erosion. The tool used to analyze overland water erosion on the parcel was the Universal Soil Loss Equation (USLE). The equation, although not designed for analyzing erosion on rangeland, aids in comparing soils for their susceptibility to water erosion losses. Site specific predicted soil erosion movement ratings for conditions analyzed on the parcel during November and December 1979 are listed in Table 3-4.

The predominant mapping units on the parcel are predicted to have moderate soil erosion (69.8 percent of the parcel), while 11.4 percent of the parcel is predicted to have high present erosion rates, 14.0 percent is predicted to have very high erosion rates, and 4.8 percent of the parcel is predicted to have a low erosion rate. Water erosion susceptibility by landscape type is shown in Figure 3-3. The effect of soil erosion movement on surface water quality is discussed in Section 3.1.4.

TABLE 3-4

PREDICTED BASELINE WATER EROSION LOSSES, SOILS OF THE HUERFANO RIVER PARCEL

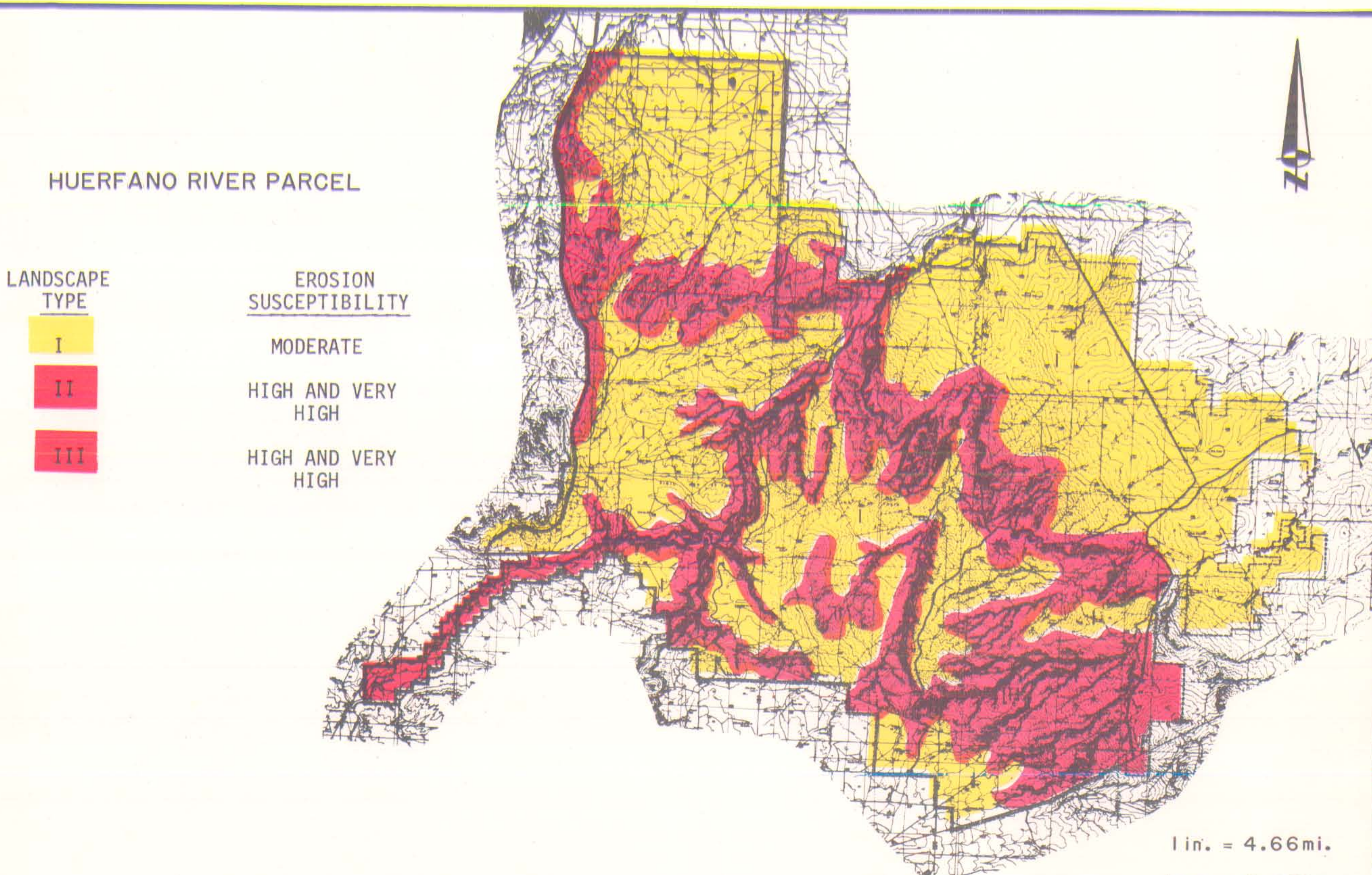
Mapping Unit Symbol	Range Site Components	Water Erosion Losses	Percentage of Parcel
LP	Loamy Plains	Moderate[1]	57.2
SB	Sandstone Breaks	Moderate	12.6
PR	Limestone Breaks-Pinyon Juniper	Very High	9.4
PmE	Limestone Breaks-Loamy Plains	High	5.4
SO	Saline Overflow	Low	4.6
TrG	Pinyon-Juniper-Rockland	Very High	4.6
AP	Alkaline Plains	High	5.2
SP	Shaly Plains	High	0.8
SM	Salt Meadow	Low	0.2

[1] Based on soil erosion classes
Low = 0-2 T/ac/yr,
Moderate = 2-4.9 T/ac/yr,
High = 5-10 T/ac/yr, and
Very High = 10+ T/ac/yr.
(T/ac/yr = Tons/acre/year)

When high intensity thunderstorms occur on the parcel, soils with crusted surfaces often cause water to puddle before the soil has become deeply wetted. For this reason, even though the amount of precipitation received may be low, muddy conditions may occur during or immediately after a rain. The tendency of water to run off these soils also increases the likelihood of gully formation. Further, the soils of the parcel are not cohesive enough to resist shearing and soil movement due to channeled water erosion forces. At present, the clumps of blue grama sod on many of the soils of the parcel serve as minor velocity breaks for water flow. Gullying occurs predominantly along cattle trails and unimproved roads.

Wind Erosion

Landscape cover and physical soil characteristics determine a mapping unit's susceptibility to wind erosion. Soil units with tree cover, scattered rock fragments and topographic diversity, including the limestone ridges and breaks units (PR,PmE) and the canyon and sandstone breaks units (SB,TrG), are the least susceptible to wind erosion. Table



GENERALIZED POTENTIAL WATER ERODIBILITY

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3-5 shows the relative susceptibility of each mapping unit to wind erosion when protective vegetation cover is removed.

TABLE 3-5

WIND EROSION SUSCEPTIBILITY
OF EXPOSED SOILS, HUERFANO RIVER PARCEL

Mapping Unit Symbol	Range Site Components	Wind Erosion Losses	Percentage of Parcel
LP	Loamy Plains	High[1]	57.2
SB	Sandstone Breaks	Low	12.6
PR	Limestone Breaks-Pinyon Juniper	Low	9.4
PmE	Limestone Breaks-Loamy Plains	Low-Moderate	5.4
SO	Saline Overflow	High	4.6
TrG	Pinyon-Juniper-Rockland	Low	4.6
AP	Alkaline Plains	High	5.2
SP	Shaly Plains	High	0.8
SM	Salt Meadow	Low	0.2

[1]Based on tree cover, rock and litter cover, and aggregate stability of each mapping unit, see Appendix C.

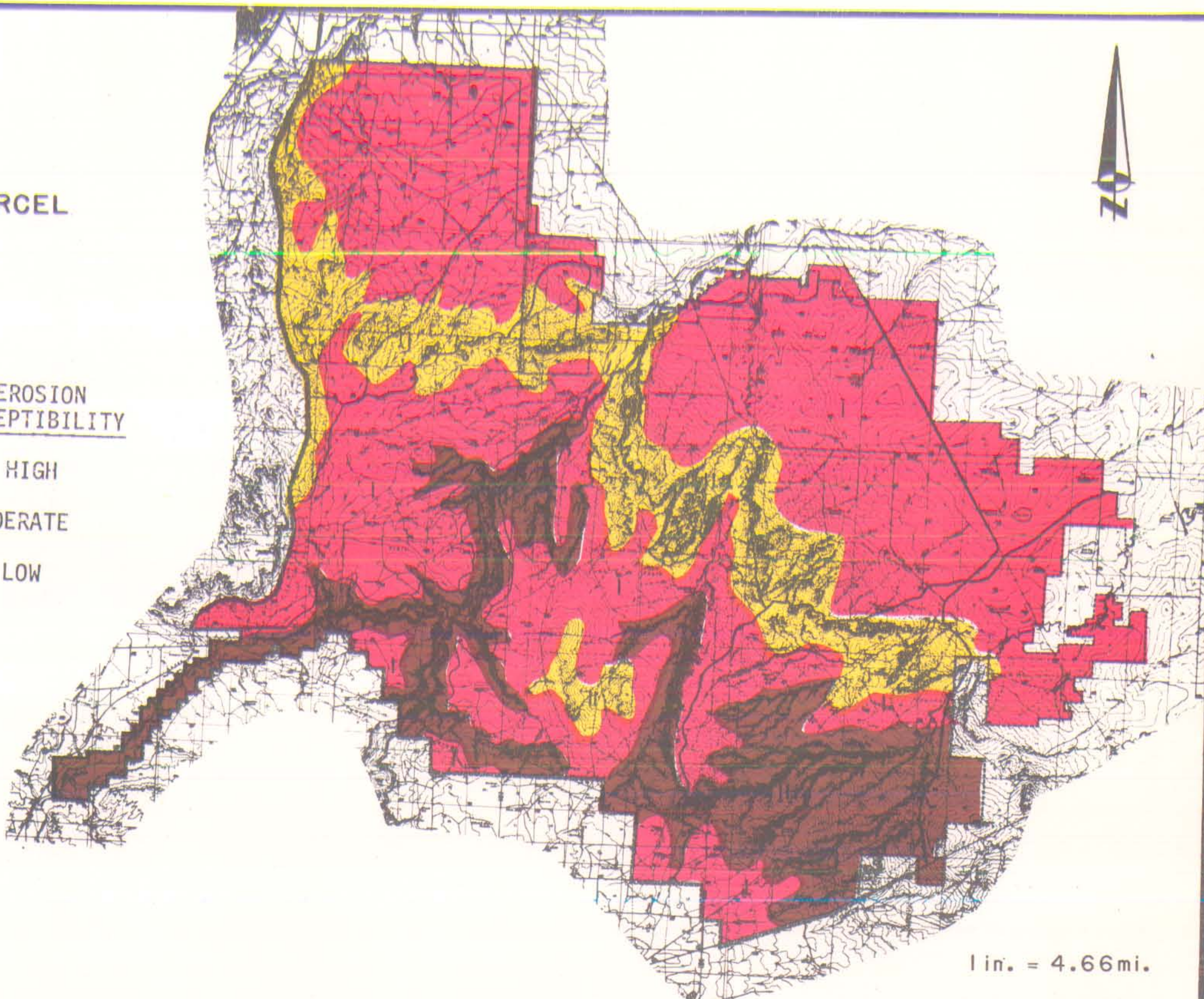
The predominant landscape type of the parcel, the open flat-lying grassed plain, including LP, AP, SP and SM mapping units, is the most susceptible to wind erosion. Trees and shrubs are rare, and the soil surfaces commonly have less than 5 percent rock fragments scattered on the surface. Sod clumps and surface crusts partially protect the soil surface under natural conditions, however, when disturbed or exposed, these soils are highly susceptible to wind erosion losses. This is discussed further in Section 3.1.6. Figure 3-4 shows wind susceptibilities of the landscape types.

3.1.3 Vegetation

Geographical Setting and Vegetation

Most of the Huerfano River Parcel is within the Upper Arkansas Valley Rolling Plains Major Land Resource Area (USDA Soil Conservation Service, 1972, Rev. 1979, see Figure D-1). The vegetation is shortgrass plains and Pinyon-juniper woodland with minor areas of riparian communities (Kuchler, 1975). Appendix D contains a list of 48 plant species indicating their relative abundance on this Land Resource Area.

HUERFANO RIVER PARCEL



LANDSCAPE TYPE	EROSION SUSCEPTIBILITY
I	HIGH
II	MODERATE
III	LOW

1 in. = 4.66 mi.

1 cm. = 2.95 km.

GENERALIZED POTENTIAL WIND ERODIBILITY

Vegetation Transect Studies

The vegetation of the parcel was selectively studied by means of belt transects 100 meters long by 5 centimeters wide. Two transects were examined for each of the major range sites on locations chosen as typical areas of soils and vegetation of the range site. Transects were given numbers for purposes of data collection and referencing. Their locations are shown by symbol and number on the maps of the management units, Appendix A. Transect study methodology is detailed in Appendix D.

Transect studies facilitated the gathering of information on the present vegetation of range sites of the parcel. Close-up examination of plant cover and composition of the vegetation at each transect provided information for use in judging range condition of the parcel. Specific data from transects were used as reference areas for determining range condition of the parcel's range sites. Table 3-6 summarizes transect data elaborated on in Appendix D.

Range Site Stability

Range sites were classed into stability groups based on their ability to sustain disturbances and their response to opportunities to recover. This has been discussed in Section 2.4, and mapped on Figure 3-5.

Range Site Descriptions

Range sites as described by the SCS that occur on the parcel are described in Appendix D. Soils and vegetation for the sites are summarized on Table 3-3.

Range Condition

Vegetation and soils develop, over time, into an established community of plants on mature soil on each natural land unit. This natural state has been termed a "climax" or the "potential plant community" for a vegetation type.

Rangeland vegetation which has deteriorated from the climax state has been classified into condition classes following Soil Conservation Service guidelines. These classes, based primarily on the kinds and amount of plants presently occurring on a range site, as opposed to climax condition, are: Excellent (76-100 percent), Good (51-75 percent), Fair (26-50 percent) and Poor (0-25 percent).

The range condition of the present vegetation of the sites, as determined by field surveys in 1979, is described below and shown on Table 3-6.

The Loamy Plains range site, 59.4 percent of the parcel, has an average range condition of Fair. Most of the sparse cover is formed by

TABLE 3-6

SUMMARY OF FIELD TRANSECTS ON THE HUERFANO RIVER PARCEL

Range Site	Transect Number[a]	Percentages				Present Range Condition[d]
		Plant Cover[c]		Litter Cover	Rock Cover	
		Optimum[b]	Present			
Loamy Plains	2	20	11.4	2.7	Trace	Fair
Loamy Plains	3	20	13.4	2.9	Trace	Good
Sandstone Breaks	5	30	14.6	4.2	25.5	Fair
Sandstone Breaks	11	30	10.8	7.4	30.7	Fair
Limestone Breaks	7	25	12.2	7.8	28.2	Fair
Limestone Breaks	10	25	12.4	2.9	58.7	Fair
Alkaline Plains	4	25	6.2	3.4	Trace	Poor
Alkaline Plains	9	25	11.4	6.4	1.4	Poor
Saline Overflow	1	50	4.6	30.8	0	Poor
Saline Overflow	6	50	12.1	14.3	0	Poor
Salt Meadow	8	50	4.2	33.1	0	Poor
Salt Meadow	12	50	2.6	33.7	1.5	Poor

[a] Data for numbered transects are in Appendix D. Location of transects are shown on maps of management units, Appendix A.

[b] From SCS Range Site Descriptions.

[c] Cover is ground obscured by native perennial plants, litter or rock when viewed from directly overhead.

[d] Based on SCS Range Condition Guides--primarily on kind and amount of plant species.

blue grama. Localized areas of Loamy Plains in Poor condition are usually near watering places where livestock have concentrated. Estimated production in pounds of plant growth per acre air dry[1] for the site in 1979 was 1250. The openness of the plant cover and above normal precipitation encouraged the growth of Russian Thistle, Sunflower and Kochia which contributed to the season's production.

The Limestone Breaks range site, 7.9 percent of the parcel, is often a close companion to the Loamy Plains of the Huerfano River Parcel. Although the vegetation of the site includes numerous grasses, forbs and shrubs with scattered junipers and pinyons it is dominated by blue grama. Estimated production in 1979 was 1300 pounds per acre. Channery and other fragments of shaly limestone on the soil provide protection against destruction of plants and the rocks also create more favorable soil moisture conditions than rock-free soils.

The Sandstone Breaks range site, 12.6 percent of the parcel, has juniper and pinyon trees. The range condition of the Sandstone Breaks in 1979 was judged Fair. Areas of the site that are remote from stockwater or cut off from access to livestock by natural barriers are in higher condition. Estimated production was 1400 pounds per acre with blue grama comprising 45 or more percent of that. The stoniness of this site protects plants from destruction and results in favorable soil moisture conditions for plant growth in a semiarid climate.

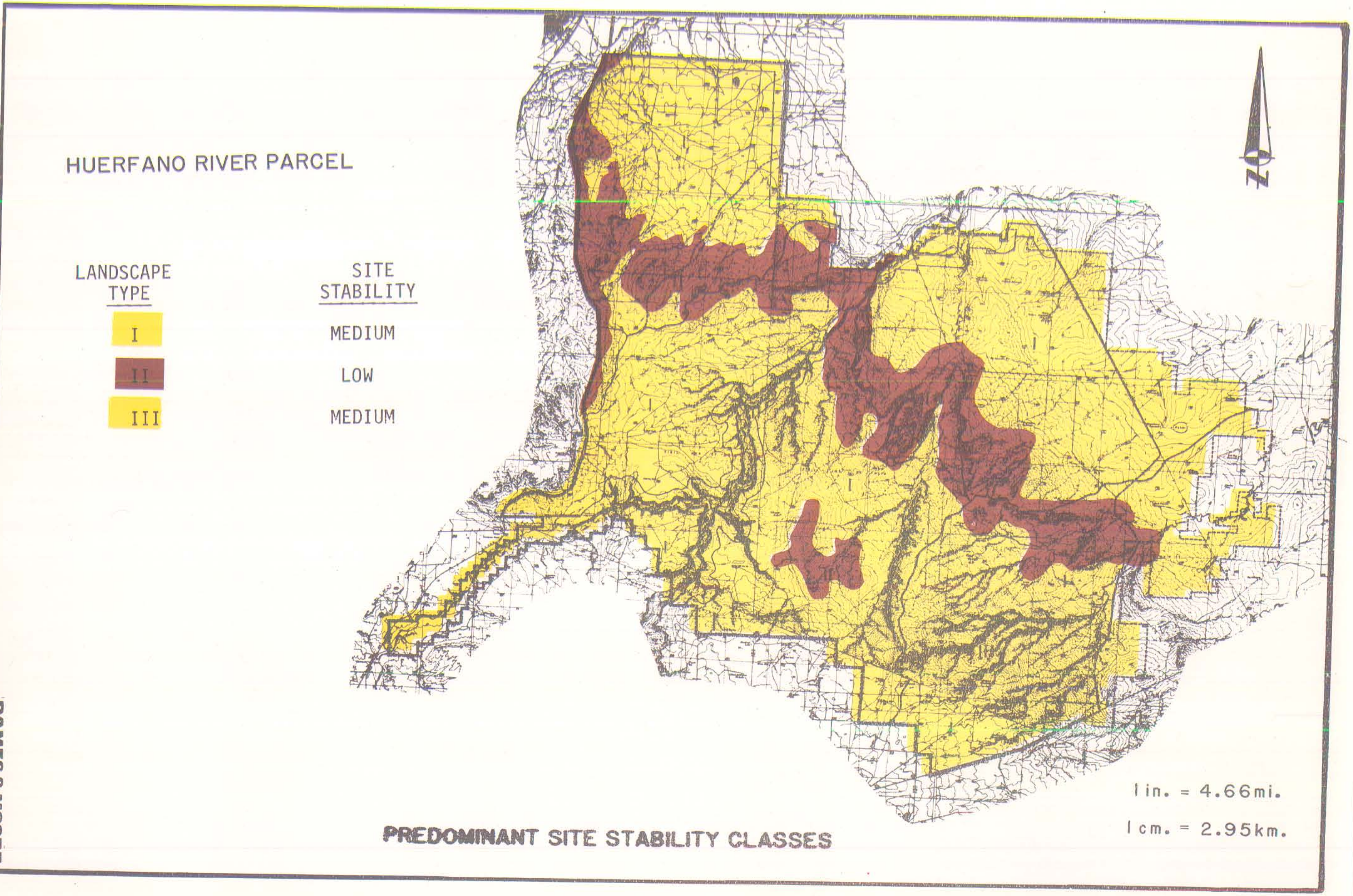
The Alkaline Plains range site, 5.2 percent of the parcel, has a present range condition of Poor, even though the site appears to have an adequate plant cover. The species and their production are not comparable to the potential. This was found in the transects where one-third to over one-half of the cover in 1979 was composed of red three-awn. Production was estimated to average 900 pounds per acre.

The Saline Overflow range site totals 4.6 percent of the parcel. Potential production for this site is high, but range condition in 1979 was generally Poor. The cover, once dominated by alkali sacaton, western wheat and other climax species is now sparse and formed by annuals and less productive plants. Blue grama made up two thirds or more or the cover. Production in 1979 was an estimated 1300 pounds per acre.

The Salt Meadow range site has a small but important percentage, 0.2 percent, of the parcel. The site is characterized by a diverse plant cover and is valuable as wildlife habitat. This potentially productive site on the parcel produced only an estimated 1200 pounds per acre in 1979 compared to a potential as high as 2500 pounds. This is attributed to the replacement of many of the meadow grasses with saltgrass which was about one third of the present vegetative composition.

Minor range sites on the Huerfano River Parcel include Shaly Plains, 0.8 percent, and Pinyon-Juniper and Rockland, 9.3 percent of the parcel.

[1]Subsequent production estimates are for an air dry basis.



PREDOMINANT SITE STABILITY CLASSES

Endangered Plant Species

The list of endangered plant species in the Federal Register, June 16, 1976 contains the plant Haplopappus fremontii sp. monocephalus (A. Nels) Hall. [Oonopsis foliosa (Gray.) Greene]. The plant is also listed in "An Illustrated Guide to the Proposed Threatened and Endangered Plant Species of Colorado" (U.S. Fish and Wildlife Service, 1978). The plant was not found on the Huerfano River parcel during vegetative studies for this report. The plant can be expected to grow, in limited abundance on the parcel, especially on the Shaly Plains and Alkaline Plains Range Site. Appendix D has additional information on the plant.

3.1.4 Hydrology

Surface Water - General Description

The rivers and streams in the Huerfano River Parcel are shown on Figure 3-6. Local topographic features and major watershed divides are also indicated. Gently rolling plains occupy the northern portion of the parcel, whereas rolling hills and arroyos are located in the southern portion. The canyon of the Huerfano River is deeply incised in the southwestern portion of the parcel where steep breaks, escarpments and canyon sides characterize the local topography.

The Huerfano River, the largest watercourse in the Huerfano River Parcel, bisects the parcel from the southwest to northeast. Its headwaters are located in the Sangre de Cristo Mountains in western Huerfano County. The river then flows in an easterly direction through canyonlands and foothills to emerge on the plains near Badito, Colorado. It then trends northeast near Delcarbon, Colorado, and flows through several canyons to its confluence with the Arkansas River about 12 miles (19 kilometers) north of the parcel near Boone, Colorado. The average gradient of the Huerfano River in the parcel is 27 feet per mile (5 meters per kilometer) (Follansbee and Sawyer, 1948). The lower Huerfano River within the parcel is intermittent, probably because of the water used by existing surface water appropriators. Some surface waters are diverted from within the parcel and used for agriculture in contiguous valley areas downstream of the parcel.

The Cucharas River, a major tributary to the Huerfano River, also rises in the Sangre de Cristo Mountains in Huerfano County (near Cucharas, Colorado) and has its confluence with the Huerfano River in the southwestern portion of the parcel. The Cucharas is also intermittent because of water use requirements.

The St. Charles River, another major tributary to the Arkansas River, borders the extreme northwestern corner of the Huerfano River Parcel. This river is also intermittent, due primarily to diversions for agriculture and industry. Although it only borders the parcel, several ephemeral streams located within the parcel drain into it, as shown on

Figure 3-6. Other drainages on the parcel are tributary to the Apishapa River which is east of the Huerfano River Parcel and joins the Arkansas River near Fowler, Colorado.

There are no large water reservoirs or impoundments in the Huerfano River Parcel. Over 100 stock ponds are reported to be in the parcel (Johnston, 1977).

Streamflow

Continuous-record streamflow data in the Huerfano River Parcel are presently not available. However, the available flow records of the Huerfano River at a discontinued U.S. Geological Survey (USGS) gaging station (07116000) located about 8 miles southwest of the Huerfano Valley Dam near Undercliffe, Colorado, best illustrate the past runoff conditions along the main-stem lower Huerfano River. The average discharge for the Huerfano River at this station for the 28-year period was 34.4 cubic feet per second (cfs) or about one cubic meter per second (m^3/sec). Average annual discharges for the period of record (water years 1940-1967) are presented in Table E-1. Maximum and minimum flows reported for each year and other pertinent data are also included.

Little information is available on flooding in the Huerfano River Parcel. The best flooding information available is for the USGS gage site near Undercliffe. At this site the highest flood recorded on the lower Huerfano River occurred in July 1958. According to local residents, this flood produced the maximum stage and discharge since at least 1900 (U.S. Geological Survey, 1974). Flood data presented as peak stages and discharges for this station are included in Table E-1, Appendix E.

Accounts of historical flooding on the Huerfano River are discussed in U.S. Geological Survey Water-Supply Paper 997. A peak discharge of 26,600 cfs (753 m^3/sec) was computed for the Huerfano River above the crest of the diversion dam of the Huerfano Valley Dam near Undercliffe for the flood that occurred in July 1936. During this flood, the headgates of the ditch were closed. The peak was reported to last from two to three hours. Discharge at the mouth of the Huerfano River was reported by the Pueblo Star-Journal (28 July 1936) to be 5,000 cfs (142 m^3/sec).

The flood season for the lower Huerfano River Valley generally occurs during the late spring and summer months. Late spring snow storms at the higher elevations and high-intensity rains over the plains region can produce rapid runoff characterized by high peak flows of short duration and relatively small volume. The duration of floods on the tributaries would generally be shorter than those on the main-stem Huerfano or St. Charles Rivers. Also, peak discharges and runoff volumes from a storm event of a given frequency would generally be smaller on the tributaries than on these rivers.

No flow has occurred for many days in the lower Huerfano River in each year. Diversions above the station for irrigation of land totalling about 43,000 acres (17,402 hectares) have been reported during the period of record (U.S. Geological Survey; 1955, 1964, 1969, and 1974). These diversions have been and still are responsible for depleting the natural streamflow.

Surface Water Use

Diversion headgates from the Huerfano River in the parcel are for both the Huerfano-Cucharas and Farmers-Nepesta Irrigation Companies (Figure 3-6). About 2,000 acres (809 hectares) of lands irrigated by these systems are outside the parcel. The estimated average annual diversions through the Huerfano Valley Ditch total about 6,500 acre-feet (8,014,500 cubic meters). Estimated average annual diversions through the Farmers-Nepesta Ditch could approximate 200 acre-feet (246,600 cubic meters) under assumed conditions of strict administration. Surface water use in the Huerfano River Parcel is discussed in detail in Appendix E, as reproduced from the report Ground and Surface Water Resources, Huerfano Expansion Site, Fort Carson Military Reservation, Colorado, prepared by J.W. Patterson & Associates, Inc. (1980).

Quality of Surface Water

Arkansas River

The chemical quality of water in the Arkansas River deteriorates downstream from Pueblo, as compared to upstream quality. Iron, sulfate, sodium and fluoride concentrations exceed Colorado water quality standards. The hardness and dissolved solids concentrations are increased, due mostly to irrigation-return flows and from minerals dissolved from soluble rock strata (U.S. Bureau of Reclamation, 1972). It is noteworthy that both the Huerfano River and St. Charles River drain alkali watersheds and contribute significantly to the dissolved salt concentrations in the Arkansas River (Misbach, 1973). The Huerfano River reportedly carries heavy concentrations of suspended solids just north of Walsenburg, Colorado. These concentrations are reported to occur naturally and are sufficient to affect aquatic life (Colorado Department of Local Affairs and Huerfano-Las Animas Council of Governments, 1979).

Huerfano River

The proposed stream classification for the Huerfano River in Pueblo County is seasonal-agricultural. Stream classification categories are proposed by the Colorado Water Quality Control Section (Table E-2, Appendix E).

The Colorado Department of Health collected water samples from both the St. Charles and Huerfano Rivers just above their confluences with the Arkansas River during the water quality survey from November

1971 through June 1972 (Dames & Moore, 1978b). These tributaries to the Arkansas River were sampled at Highway 50 bridge locations outside the boundary of the existing Huerfano River Parcel. The maximum total dissolved solids (TDS) reported were 5,100 parts per million (ppm) in the Huerfano River. The U.S. Public Health Service recommends a limit of 500 miligrams per liter (mg/l) for dissolved solids in drinking water. One mg/l is equivalent to 1 ppm. Additional water quality data obtained by the Colorado Department of Health for the Huerfano River near Boone indicate excessive concentrations of TDS and fecal coliforms (Dames & Moore, 1978a). It is reported that no drinking water is directly derived from the Huerfano River (U.S. Army, Environmental Feasibility Review, Huerfano River Site, date unknown).

Selected physical, chemical, and bacteriological water quality characteristics of the lower Huerfano River and are summarized in Table 3-7. These and other water quality characteristics are included in Table E-3. Data are from samples tested as a part of the Pueblo Area 208 Water Quality Program.

From water samples analyzed, cadmium was found to be 0.09 mg/l in excess of the limit and TDS 1,212 mg/l in excess of the limit proposed for agricultural classification of the Huerfano River. Further testing for cadmium, however, is being considered, since its testing was limited to two samples only (Pueblo Regional Planning Commission, 1977), and should not be considered as representative.

Periodic field conductivity measurements were made in the lower Huerfano River at the U.S. 50 bridge by an irrigation engineer over a three-year period. Results of these measurements are summarized below (Miles, 1980):

Date	Field Conductivity (mmhos/cm)
August 3, 1976	2.38
June 13, 1977	2.01
August 1, 1977	2.10
August 10, 1977	2.43
August 19, 1977	1.97
July 10, 1978	2.47
July 11, 1978	2.04
August 30, 1978	2.08

Conductivity measurements in surface waters are commonly used as an indicator for TDS concentrations (see Glossary). All measurements were reportedly taken during periods of flood, where storm runoff appeared to be originating in the eastern portion of the basin. It is expected that field conductivity measurements taken during periods of low flow could be greater than those indicated above for local flood flows, because of lesser dilution effects of streamflow on the chemical constituents in the water.

TABLE 3-7

SELECTED WATER QUALITY PARAMETERS IN THE HUERFANO RIVER[a]

Parameter	Concentration[b]			Reduction from Mean Value Necessary to Meet Proposed Classification
	Minimum	Maximum	Average	
BOD	1.2	12.8	5.1	N.A.[c]
Cadmium μg/l	.05	0.10	(only 2 samples)	0.009
Chlorine Residual	0	0	0	N.A.
Dissolved Oxygen	7.0	10.2	8.8	N.A.
Total Dissolved Solids	861.0	4813.0	2212.0	1212
Fecal Coliform (specimens/100 ml)	5.0	820.0	323.0	0
pH (SU)	7.9	8.3	8.1	N.A.
Temperature °C	4	33	14.0	N.A.
Total Suspended Solids	28.0	965.0	341.8	N.A.

[a]See full summary on Table E-3, Appendix E.

[b]mg/l except where noted.

[c]Not Applicable.

Cucharas River

The present uses for the Cucharas River below Walsenburg at Interstate Highway 25 to its confluence with the Huerfano River are reportedly for warm water aquatic life and irrigation/stock supply (Colorado Department of Local Affairs and Huerfano-Las Animas Council of Governments, 1979).

The Cucharas River in the Huerfano River Parcel is also expected to have marginal water quality. This river receives municipal discharges outside the parcel from the towns of Cucharas, La Veta and Walsenburg, and from some subdivisions. At Walsenburg, dissolved oxygen (DO) in the river water is often below the standard 5 mg/l; TDS reaches 1,200 mg/l, and the fecal coliform counts often exceed the standard of 1,000 organisms/100 milliliters.

St. Charles River

The proposed stream classifications for the lower St. Charles River are agricultural and surface water supply (Pueblo Regional Planning Commission, 1977). The lower St. Charles River is also a designated limited fishery resource (Colorado Division of Wildlife, 1979).

Water samples were collected by the Colorado Department of Health from the St. Charles River above its confluence with the Huerfano River. The maximum total dissolved solids (TDS) were 2,330 parts per million (ppm). Selected physical, chemical and biological water quality characteristics of the St. Charles River are summarized in Table 3-8. Table E-4 includes complete information on water quality characteristics.

However, it should be pointed out that about 3-1/2 miles (5.6 kilometers) north of the Huerfano River Parcel, treated wastewater from the Comanche Electric Generating Station (owned by Public Service Company of Colorado) is discharged into the St. Charles River. During observed low-flow periods of the St. Charles River, there has been no flow upstream of the Comanche Plant outfall. Thus, the water quality in the St. Charles River downstream of the outfall would be that of the plant's effluent quality. Table E-5 (in Appendix E) presents a summary of the Comanche Plant effluent quality as acquired during the Pueblo Area 208 Water Quality Program. Table E-6 (in Appendix E) lists the NPDES permit limitations for the Comanche Plant discharge. Results of self-monitoring tests are reported by the Comanche Plant which show substantial compliance with all NPDES permit limitations. However, occasional violations of permit limitations have been observed. These violations were for concentrations of suspended solids, zinc and BOD_5 found in excess of permit limitations (Pueblo Regional Planning Commission, 1977).

Another a potential point source of pollution to the St. Charles River in the proximity of the Huerfano River Parcel would be a land disposal area, approximately 236 acres (96 hectares) in size, located about a mile south of the Comanche Plant and immediately south of the St.

TABLE 3-8

SELECTED WATER QUALITY PARAMETERS IN ST. CHARLES RIVER[a]

Parameter	Concentration[b]			Reduction from Mean Value Necessary to Meet Proposed Classification
	Minimum	Maximum	Average	
BOD	2.7	12.1	6.4	N.A.[c]
Cadmium	0	0.001	(only 2 samples)	0
Chlorine Residual	0	0	0	N.A.
Dissolved Oxygen	8.3	13.5	10.4	N.A.
Total Dissolved Solids	93	2215.0	1519.0	1019
Fecal Coliform (specimens/100 ml)	20.0	570.0	154.0	0
pH (SU)	7.3	8.4	7.9	N.A.
Temperature °C	2	27	14	N.A.
Total Suspended Solids	8.0	1110.0	175	N.A.

[a]See full summary on Table E-4, Appendix E.

[b]mg/l except where noted.

[c]Not Applicable.

Charles River. An earthen dike 15 feet (4.5 meters) high separates the dump area and the river. Sludge from the ash settling ponds at the Comanche Plant is reportedly hauled and dumped there under contract (Pueblo Regional Planning Commission, 1977). Drainage of leachate water to the St. Charles River is a possibility.

Pollution Sources within the Huerfano River Parcel

No point sources of pollution were identified on the area of the Huerfano River Parcel during the 208 Impact Studies performed according to Section 208 of the Federal Water Pollution Control Act (Pueblo Regional Planning Commission, 1977; Colorado Department of Local Affairs and Huerfano-Las Animas Council of Governments, 1979).

Sediment yield is the only nonpoint source of pollution in the Huerfano River Parcel (Pueblo Regional Planning Commission, 1977). The Huerfano River Parcel features areas characterized by severely eroding stream banks and deep gullies (U.S. Department of Agriculture, 1979). These severely eroding watercourses are shown on Figure 3-6. Saline formations, which inherently contribute to dissolved salts in the streambeds along the Cucharas and Huerfano Rivers in Huerfano County reportedly contribute to very high sediment yields and to salinity in these rivers (U.S. Department of Agriculture, 1979; Colorado Department of Local Affairs and Huerfano-Las Animas Council of Governments, 1979).

For anticipated average annual runoff conditions, potential annual sediment yields in ton per square mile per year for major watershed areas within the preferred boundary of the Huerfano River Parcel were estimated. Results are presented in Table 3-9. The method of analysis is discussed in Appendix E.

Results of the sediment analyses indicate that most lands on the Huerfano River Parcel are subject to potentially moderate sedimentation to waters (range 870 to 1,580 tons per square mile per year) under average annual runoff conditions. However, the watershed area of Doyle Arroyo is estimated to produce a low sediment yield (840 tons per square mile per year). The estimated total average annual sediment loading from lands within the parcel is 1,190 tons per square mile. This is lower than the annual sediment yield of 1,845 tons per square mile reported for the Apishapa River at Fowler, Colorado, in the region (U.S. Department of Agriculture, 1980).

Estimated annual sediment yields (Table 3-9) are variable throughout the Huerfano River Parcel, but a general comparison can be made. The potential for estimated average annual sediment loading to the Huerfano River from the local contributing drainage area west of the Huerfano River is about the same as that estimated from the local contributing drainage area east of the river.

TABLE 3-9

ESTIMATED TOTAL SEDIMENT YIELDS IN MAJOR WATERSHED AREAS WITHIN PREFERRED BOUNDARY OF HUERFANO RIVER PARCEL

Designated Watershed Unit Name in Parcel	Drainage Area (square miles)	Estimated Total Sediment Yield (tons/square mile/year)
Local Area to St. Charles River (includes Edson Arroyo)	39.3	960
Sixmile Creek	15.7	870
Fourmile Creek	15.1	1,090
Local Area to Huerfano River (western portion); excludes 4.7 square miles of Huerfano Canyon in southwest part of parcel	59.6	1,440
Local Area to Huerfano River (eastern portion)	45.3	1,420
Local Area to Cucharas River	8.8	1,580
Doyle Arroyo	55.1	840
North and South Chicosa Creeks	35.5	1,160
Hardesty Draw Drainage	0.4	890
Mustang Creek	63.2	1,320
	Average for Parcel	1,190

NOTE: Local area refers to contributing intervening drainage area between major watershed divides.

Based on U.S. Department of Agriculture, 1980:
- Very High Sediment Yield - 5100 tons per square mile per year
- High Sediment Yield - 1700-5100 tons per square mile per year
- Moderate Sediment Yield - 850-1700 tons per square mile per year
- Low Sediment Yield - 340-850 tons per square mile per year
- Very Low Sediment Yield - less than 340 tons per square mile per year

Conversion Factors:
- 1 square mile = 259,093 hectares (approximately)
- 1 ton/square mile/year = 2.8 x 10^{-6} m^3/hectare/year (approximately)

Ground Water Hydrology

The Dakota Sandstone and the basal member of the Purgatoire Formation, the Cheyenne Sandstone, are the principal bedrock aquifers producing usable ground water within the Huerfano River Parcel. Relative thickness and approximate depth to the two principal aquifers are shown in Figure 3-7, a generalized geologic cross-section through the parcel. Table 3-10 lists the water-bearing characteristics of the major geologic units found on the parcel. Review of existing ground water data, including compilation of data for wells which are recorded at the Colorado State Engineer's Office (Patterson & Associates, 1980) (Figure 3-6) indicates estimated aggregate production from wells believed to tap the two principal bedrock aquifers to be approximately 1,000 gallons per minute (gpm), (63 liters/second [l/s]). Approximately 70 percent of the estimated production is derived from the eastern one-third of the parcel. The well data available are of questionable interpretive value as much of the data were obtained over 30 years ago and may not accurately reflect present conditions. The unconsolidated alluvial aquifer in the Huerfano River floodplain has been developed for irrigation purposes, with reported well yields exceeding 250 gpm (16 l/sec) (U.S. Army Environmental Feasibility Review, Huerfano River Site, no date). Within the parcel the Huerfano floodplain has not been utilized as a ground water source, possibly because of insufficient saturated thickness to allow development.

Ground water supplies in the proposed Cedarwood cantonment area, which is situated on the western side of the parcel, appear to be limited. An alternative location on the parcel where ground water supplies may be more promising is at least 12 miles (19 km) east of the present cantonment area. However, additional field testing will be required to confirm the quantity and quality of ground water on the parcel.

Limited data are available on ground water quality for existing wells within the parcel boundary. Chemical analyses of ground water from wells located several miles south of the parcel boundary (McLaughlin, 1966) indicate that ground water is adequate for stock watering and occasionally for domestic use. Dakota Sandstone generally yields water with total dissolved solids (TDS) in excess of 1,000 milligrams per liter (mg/l), while the Purgatoire Formation generally yields water with a TDS in excess of 500 mg/l. No chemical data are available for ground water derived from the alluvial aquifer.

3.1.5 Wildlife

Terrestrial Wildlife Ecology

Seven different habitat types are known to occur on the Huerfano River Parcel: Pinyon-juniper breaks, rocky cliffs, river bottom, stands

TABLE 3-10

GENERALIZED SECTION OF THE GEOLOGIC FORMATIONS IN THE HUERFANO RIVER PARCEL

System	Series	Symbol	Subdivision	Member	Thickness (feet)	Physical Character	Water Supply
QUATERNARY	Recent	Qal	Alluvium		0-50	Sand and Gravel	Yields adequate quantities of water for domestic and stock use. Locally yields suffiecnt water for irrigation.
CRETACEOUS	Upper	Kn	Niobrara Formation	Smoky Hill Marl	400-500	Gray to buff calcareous to chalky and sandy shale with thin limestone beds	Locally yields small quantities of water to a few domestic and stock wells
				Fort Hays Limestone	50-70	Light-gray limestone with thin chalky shale partings	Yields water to many domestic and stock wells
		Kcgg	Carlile Shale	Codell Sandstone	5-30	Sandstone and shaly sandstone	Yields water to many domestic and stock wells
				Blue Hill Shale	220-260	Gray to black shale	Does not yield water to wells
			Greenhorn Limestone		25-35	Thin gray limestone interbedded with dark-gray calcareous shale	Yields small quantities of water to a few domestic and stock wells
			Graneros Shale		185-235	Platy chalky shale	Yields no water to wells in Huerfano River Parcel
	Lower	Kdp	Dakota Sandstone		115-125	Fine grained, thin bedded to massive sandstone containing clayey and sandy shale	Yields water for domestic and stock use
			Purgatoire Formation	Kiowa Shale	15-25	Shale and sandy shale	Yields little or no water to wells in Huerfano River Parcel
				Cheyenne Sandstone	95-135	Massive white to buff fine-grained sandstone	Yields water to many wells and springs in Huerfano River Parcel
JURASSIC		Jmre	Morrison Formation		260-300	Varicolored shale, siltstone and sandstone	Not known to yield water to wells in Huerfano River Parcel
			Entrada Sandstone		30-70	White to buff massive fine-to-medium grained sandstone	Not known to yield water to wells in Huerfano River Parcel
PENNSYLVANIAN & PERMIAN		PPsc	Sangre de Cristo Formation		200-3000	Sandstone, conglomerate, Limestone, and shale	Yields water to springs and seeps principally in mountainous areas

Adapted From: McLaughlin, T.G., 1966, Ground Water in Huerfano County, Colorado. U.S. Geological Survey Water Supply Paper 1805.

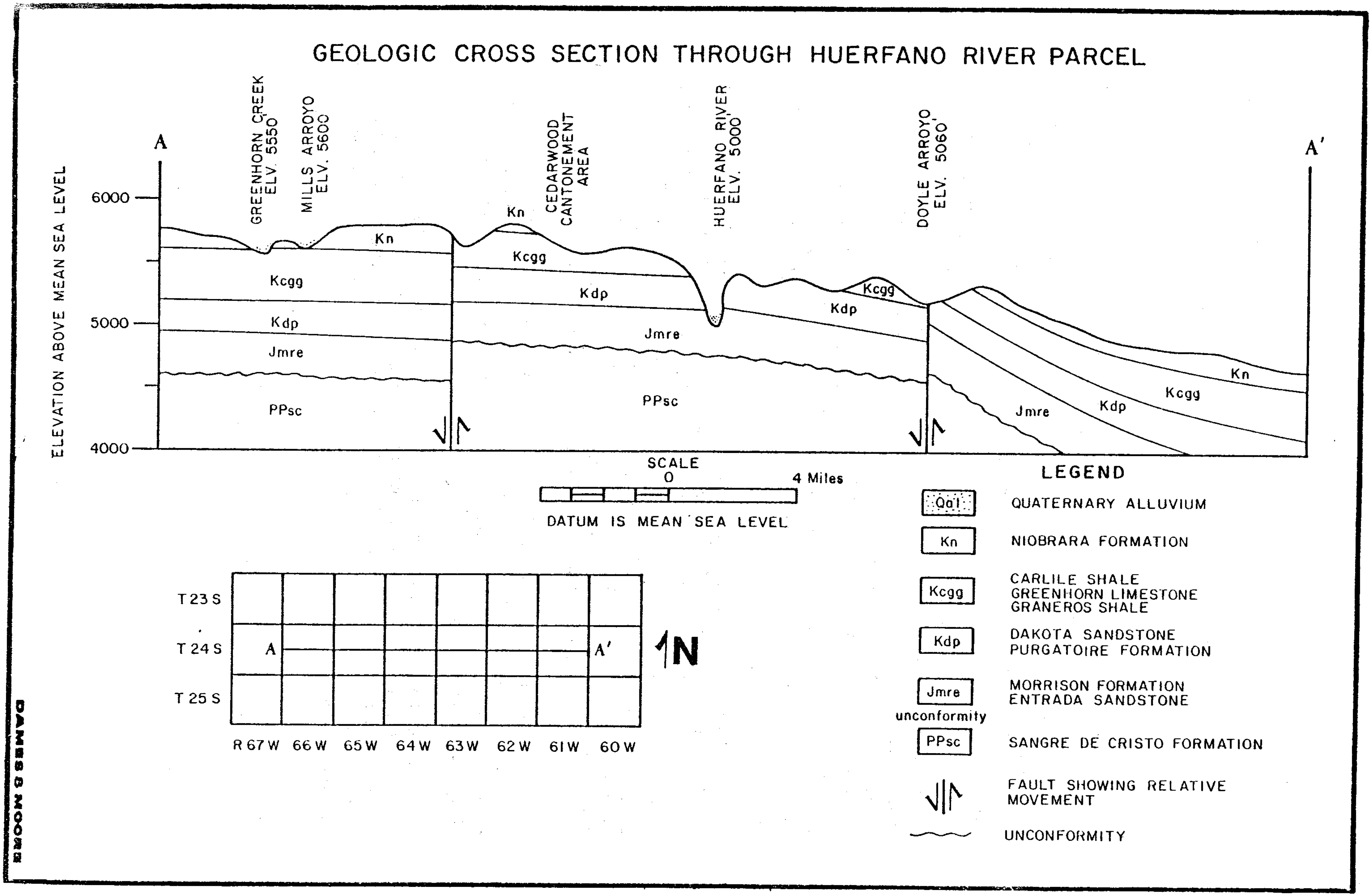

GEOLOGIC CROSS SECTION THROUGH HUERFANO RIVER PARCEL
A
A'
ELEVATION ABOVE MEAN SEA LEVEL
6000
5000
4000
GREENHORN CREEK ELV. 5550'
MILLS ARROYO ELV. 5600
CEDARWOOD CANTONEMENT AREA
HUERFANO RIVER ELV. 5000'
DOYLE ARROYO ELV. 5060'
Kn
Kcgg
Kdp
Jmre
PPsc
SCALE
0
4 Miles
DATUM IS MEAN SEA LEVEL
T 23 S
T 24 S
T 25 S
R 67 W
66 W
65 W
64 W
63 W
62 W
61 W
60 W
N
LEGEND
Qal QUATERNARY ALLUVIUM
Kn NIOBRARA FORMATION
Kcgg CARLILE SHALE GREENHORN LIMESTONE GRANEROS SHALE
Kdp DAKOTA SANDSTONE PURGATOIRE FORMATION
Jmre MORRISON FORMATION ENTRADA SANDSTONE
unconformity
PPsc SANGRE DE CRISTO FORMATION
FAULT SHOWING RELATIVE MOVEMENT
UNCONFORMITY
DAMES & MOORE

FIGURE 3-7

of deciduous trees, semi-arid grassland, shrublands, and stands of cholla. Animal species potentially occuring on the parcel are listed in Table F-1, and a discussion of representative species and their habitat affinities is also included in Appendix F.

The most important habitat types are those associated with the canyons and arroyos on the parcel. These are: 1) the Pinyon-juniper community on the canyon rim, 2) the bottom land community along the canyon and arroyo bottoms and 3) the community on the canyon walls between the two. · The first corresponds to the Limestone Breaks and Sandstone Breaks Range Sites as described in Appendix D. The second corresponds to the Salt Meadows Range Site (Appendix D).

The Pinyon-juniper community, which makes up approximately 9.3 percent of the parcel, is composed mainly of juniper with scattered shrubs and grasses typical of the Limestone Breaks and Sandstone Breaks Range Sites (see Tables D-6 and D-7). The trees provide habitat for several species of tree nesting birds such as Pinyon Jay (Cymrorhinus cyanocepholeus) and Bewick's Wren (Thrydmanes bewickii). The shrubs provide forage for Mule Deer (Odocoileus hemionus) (Figure 3-8) and other species. Both shrubs and trees provide escape cover for many species including the Mountain Lion (Felis concolor) (Figure 3-8) and protection from wind.

Bottomland habitats compose less than one percent of the parcel but supply a wide variety of forage species benefiting from the high water table of the Salt Meadow Range Site. Deciduous trees in bottomlands provide nesting sites for species such as Yellow Warbler (Dendroica petechia) and Eastern Kingbird (Tyrannus tyrannus). A very important component of the bottomland habitat is scattered seeps and pools which supply water for many species. They are particularly important during the hot summer months when they are the only water available.

The canyon walls, located along the Huerfano and Cucharas Rivers and various side canyons and arroyos, provide nest sites for several species of raptors such as Golden Eagles (Aquila chrysnetos) and Prairie Falcons (Falco mexicana) (Figure 3-9).

These three types together supply a wide variety of habitats. One of the primary tenets of wildlife ecology is that an interspersion of habitat types is better than a wide expanse of a single habitat. The canyon rims, walls and bottoms supply this interspersed habitat supporting many wildlife species.

Of the remaining range sites on the Huerfano River Parcel the Loamy Plains comprise a grassland habitat and occupy 59.4 percent of the parcel. The Saline Overflow and Akaline Plains Range Sites comprise a shrub-grassland habitat and occupy 9.8 percent of the parcel. Together, these two community types supply habitat requirements for several species including Lark Bunting (Calamospiza melanocrys) Western Meadowlark

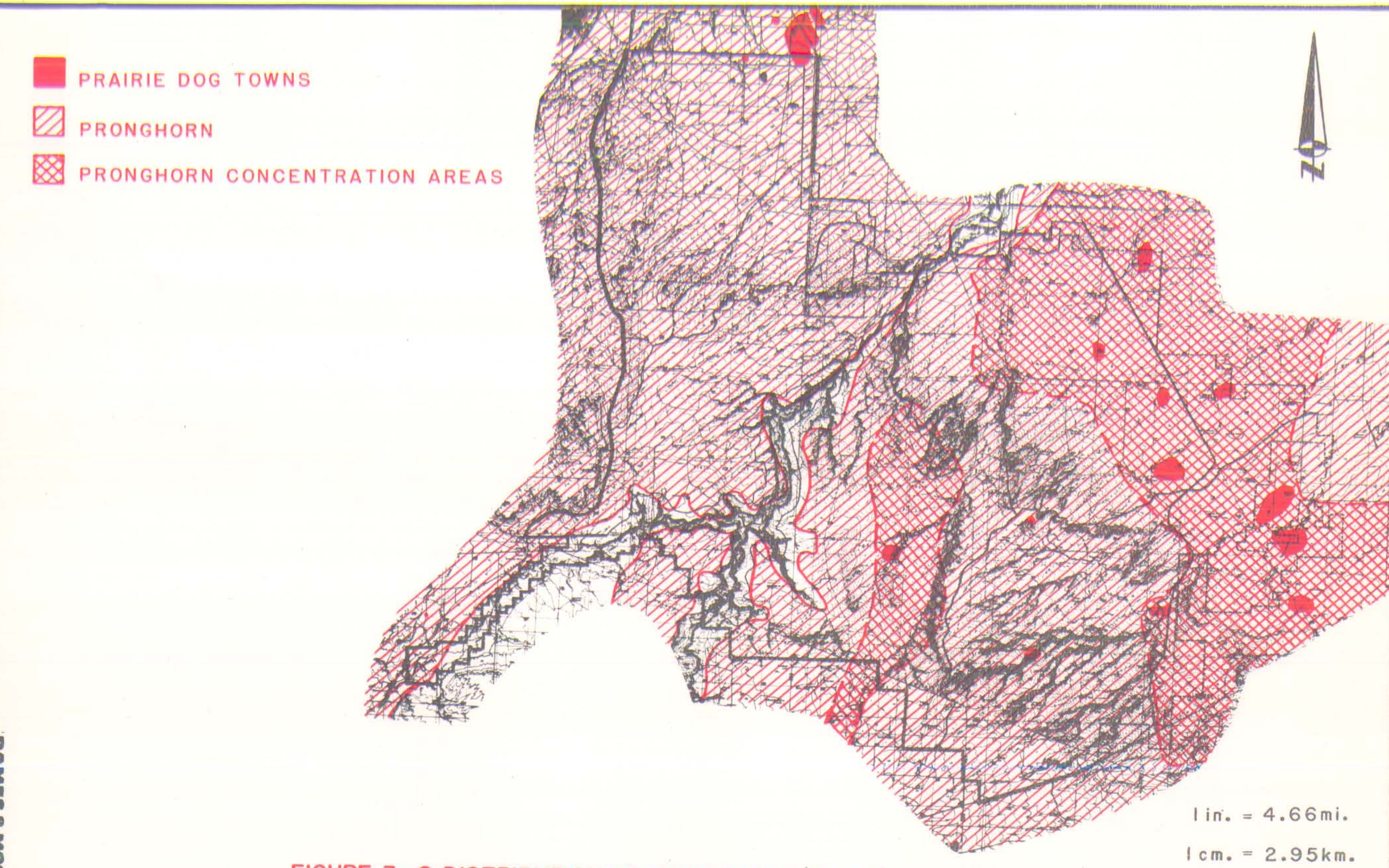


FIGURE 3–8 DISTRIBUTION OF PRAIRIE DOG TOWNS AND PRONGHORN ON THE HUERFANO PARCEL

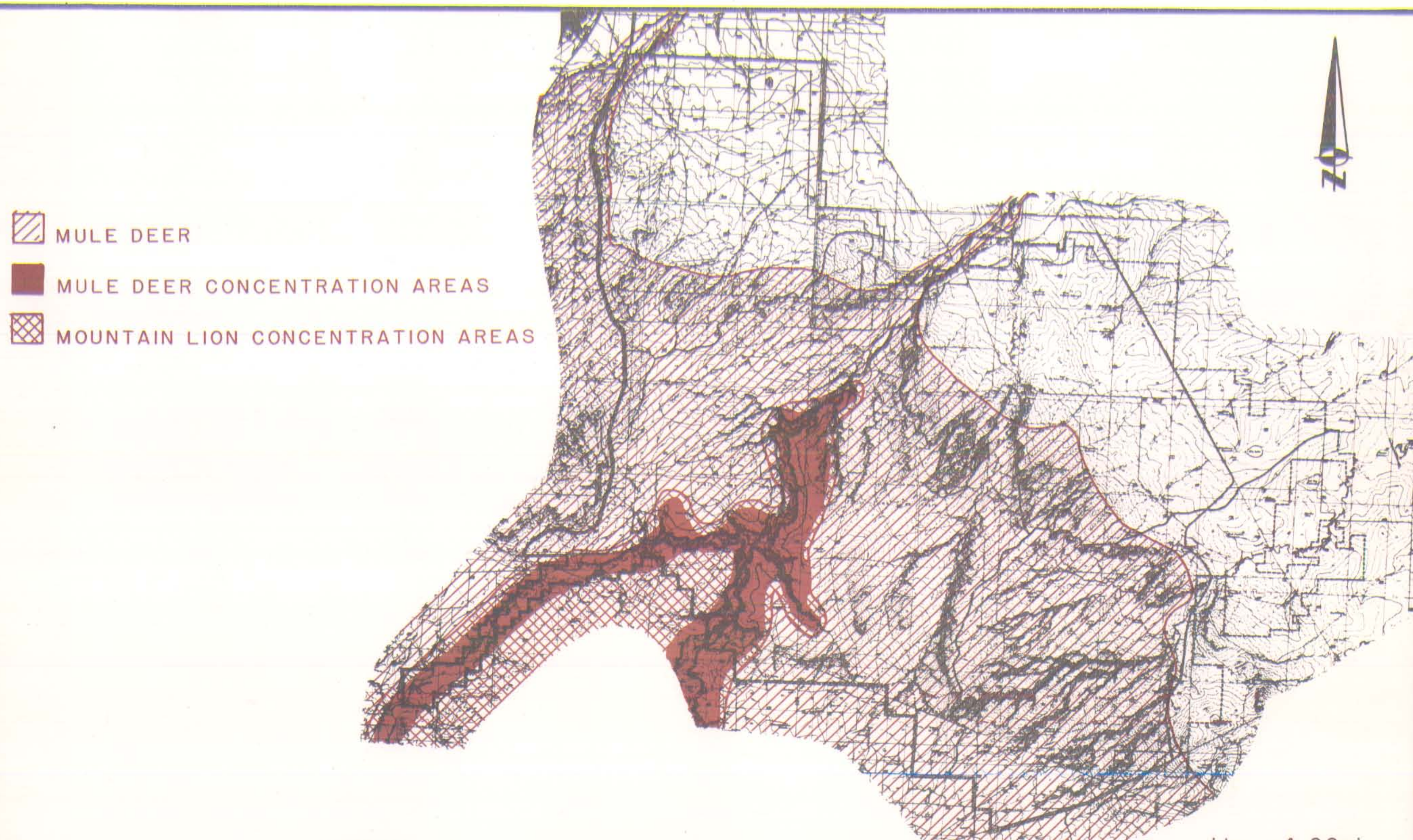


FIGURE 3-9 DISTRIBUTION OF MOUNTAIN LION AND MULE DEER ON THE HUERFANO PARCEL

DAMES & MOORE

(*Sturnella neglecta*), Mountain Plover (*Charadrius montanus*), Scaled Quail (*Callipepla squamata*) (Figure 3-9) and Pronghorn (*Antilocapra americana*) (Figure 3-10).

From a species perspective the Huerfano River Parcel offers good potential for Mule Deer and fair potential for Pronghorn and Scaled Quail (Appendix F). Since the 1978 Environmental Assessment (Dames & Moore, 1978b) Mule Deer populations in the area have increased 15 percent and Pronghorn populations have increased 20 percent.

Endangered and threatened species

Species listed as endangered by the U.S. Fish and Wildlife Service (Federal Register 19 January 1979) whose ranges include the Huerfano River parcel are Black-footed Ferret (*Mustela nigripes*), Peregrine Falcon and Bald Eagle. The following is a brief summary of the detailed discussion of each of these species which is presented in Appendix F. Consultation with the Fish and Wildlife Service as specified in Section 7 of the Endangered Species Act (16 USC 1536) has been initiated. The Fish and Wildlife Service has indicated that Bald Eagle surveys would be necessary. An aerial survey to inventory raptor species in portions of the Huerfano River Parcel was conducted on April 10 and 30, 1980. Two helicopters, each flying two observers, were utilized to conduct the survey. Detailed results are presented in Appendix F. In summary, 202 individual raptors comprising 9 species were observed. No threatened or endangered species were observed.

Black-footed Ferret

Black-footed Ferrets live in prairie dog (*Cynomys* sp.) towns and their preferred food is prairie dogs. Although a Black-footed Ferret can utilize any prairie dog town, it appears they prefer areas where towns are concentrated and most of them are at least 12 hectares in size (Hillman, et al. 1979). Seven prairie dog towns are known to occur on the Huerfano River parcel (Figure 3-3W). While these towns do not present optimum Black-footed Ferret habitat most of them are large enough to support a Black-footed Ferret (Hillman et al,. 1979). Thus potential Black-footed Ferret habitat is present. However, no Ferrets are known to occur there.

Peregrine Falcon

Peregrine Falcons which prefer to nest on cliffs near water may travel over 10 miles to feed on medium sized birds, their preferred food (Hickey and Anderson 1969; Colorado Division of Wildlife, 1978c). The Huerfano River Canyon presents potential nesting habitat for Peregrine Falcons, but presently none are known to nest there. However, sporadic observations by private individuals and Colorado Division of Wildlife personnel indicate the area is used for feeding and hunting by Peregrine Falcons during the spring and fall migrations (Colorado Division of Wildlife, 1977, unpublished files).

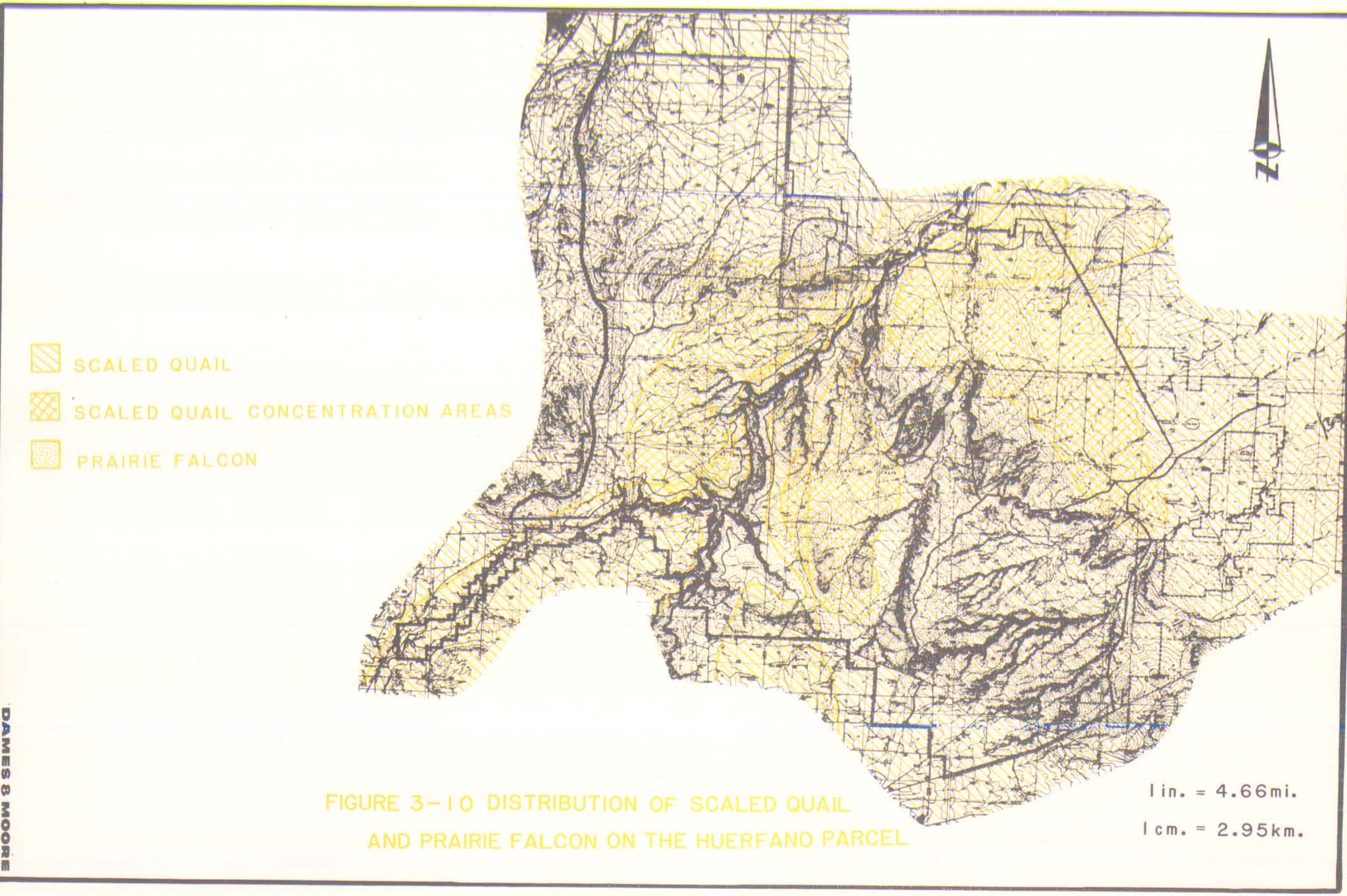


FIGURE 3-10 DISTRIBUTION OF SCALED QUAIL AND PRAIRIE FALCON ON THE HUERFANO PARCEL

Bald Eagles

Bald Eagles prefer to nest in large trees overlooking water and their preferred food is fish. However, they will also take rabbits and carrion especially during the winter (Snow, 1973). None are known to nest on the Huerfano River parcel, but they are known to use the area for feeding during the winter (Personal communication, Chuck Loeffler, Biologist, Colorado Division of Wildlife, Colorado Springs, January 6, 1980).

Aquatic Ecology

Permanent aquatic habitats on the Huerfano River Parcel are limited to a pond, seeps and box canyon pools. All waterways are intermittent due to the semi-arid climate and agricultural diversion. The Huerfano and Cucharas rivers are classified as warm water fisheries by the U.S. Bureau of Land Management, and are characteristically low productivity ecosystems. These poor habitats contain highly turbid water and a shifting substrate (Miller, 1980). Reported and potential aquatic organisms are listed in Table F-8, Appendix F.

The water quality of major tributaries, for which data exist, indicates that the waters within the Huerfano parcel are not suitable for a fisheries resource of any importance. Total dissolved solids, total suspended solids, and occasionally dissolved oxygen and fecal coliform counts, are all above levels usually considered appropriate for good warm water fisheries (see Section 3.1.4). However, the major limiting factor for diverse and sustainable fisheries appears to be the amount of water available, which within the Huerfano River Parcel is intermittent except for a few pools and small seeps.

The historical range of the Arkansas River Darter (Etheostoma cragini) and the Arkansas River Speckled Chub (Hybopsis aestivalis tetranemus), officially listed by the state of Colorado as threatened species, includes streams on the Huerfano River parcel (Colorado Division of Wildlife, 1978). The Colorado Division of Wildlife fishery survey, which did not include any sites within the Huerfano River Parcel collected four (4) individuals of the Arkansas River Darter, in El Paso and Lincoln counties north of the parcel. The Arkansas River Darter shows a preference for small springs or seeps that have coarse gravel for spring spawning with watercress or other aquatic vegetation present (Colorado Division of Wildlife, 1978). Springs and seeps occur on portions of the parcel. Whether these water bodies have all the habitat requirements is not known. No Arkansas River Speckled Chub were found (Miller, 1980). This fish shows preference for warm open channels with noticeable flow (Colorado Division of Wildlife, 1978). The intermittent nature of all of the waterways in the Huerfano River Parcel reduces the possibility for its residence.

The preceding evaluation and professional descriptions, by David Miller and Don Prichard, rate the aquatic habitats within the Huerfano

River Parcel as poor potential for warm water fisheries (Personal communication, David Miller, Ph.D. Student, Colorado Division of Wildlife Colorado State University, February 8, 1980, and Don Prichard, Aquatic Biologist, Bureau of Land Management, February 13, 1980).

Detailed data on aquatic ecology of the Huerfano River Parcel are located in Appendix F.

3.1.6 Meteorology and Air Quality

Regional Climatology

The climate of the southeastern Colorado plains, where the Huerfano River Parcel is located, is classified as a dry continental climate and is typified by low relative humidity, abundant sunshine, low rainfall, and a large range of temperatures from day to night. Summertime temperatures often rise above 90°F (32°C), but winter temperatures seldom go below 0°F (-18°C). The mean daily maximum temperature is above freezing for all months, but rapid cooling at night is common and, on the average, over 150 days per year have a minimum temperature of freezing or lower.

The majority of the precipitation falls during the growing season months of April through September, with July typically the wettest month. Almost all of the summer precipitation is associated with thunderstorms, which occur on an average of 41 days per year.

Wind speeds throughout the year are generally moderate, averaging about nine miles per hour. Higher wind speeds occur most frequently in the spring and winter, but locally high winds can occur during the summer in the vicinity of thunderstorms.

Data Base

In order to obtain a good understanding of the climate found on the Huerfano parcel, a weather station with a long-term data record is necessary. The necessity for using weather stations with long data records can be illustrated by recalling previous years with large amounts of precipitation or that were abnormally cold. The expressions "more than average" or "colder than average" are terms used in conjunction with stations that have sufficient data to obtain a reasonable average. Weather stations with short-term climatic data are not useful in establishing long-term climatic averages. Within the borders of the Huerfano Parcel, only one climatic station, Butler Ranch, has sufficient precipitation data to be considered a good climatic average. Howevever, Butler Ranch station records only precipitation. Another station must be used to obtain climatic averages for parameters such as wind direction, wind speed, temperature, and relative humidity. The Pueblo Airport is the most representative station for these parameters.

Temperature

Monthly means and extremes of temperature recorded at Pueblo are presented in Table G-1 in Appendix G. The data show that extreme temperatures have ranged from a low of -31°F (-35°C) to a high of 105°F (41°C). January is typically the coldest month with an average daily minimum of 13.9°F (-10°C) and an average daily maximum of 45.3°F (7°C). July is the warmest month with an average daily maximum of 91.9°F (33°C) and an average daily minimum of 61.5°F (16°C). The mean monthly temperatures range from 29.6°F (-1°C) in January to 76.7°F (25°C) in July. The data in Table G-2 show that the daily maximum temperatures can be expected to equal or exceed 90°F on an average of 63 days per year, and that the daily maximum will fail to rise above 32°F (0°C) on an average of 17 days per year. Daily minimum temperatures can be expected to be below 32°F (0°C) 153 days a year and below 0°F (-18°C) 9 days per year.

Mean dates of first and last occurrences of selected freeze threshold temperatures at Pueblo are presented in Table G-3. These data indicate that the average freeze-free period at Pueblo lasts 173 days, extending from April 26 through October 16.

Relative Humidity

Mean relative humidity data collected at Pueblo are presented in Table G-4. These data indicate that the average relative humidity tends to be highest in winter and lowest in spring, although there is not a substantial difference between the two seasons. On an annual basis, the average diurnal range of humidity varies between approximately 35 and 66 percent.

Precipitation

Precipitation on the southeastern plains of Colorado arises from two different seasonal-dependent regimes. The first of these is a large-scale weather system commonly called a synoptic weather system. During the period from October to May, synoptic weather systems produce a majority of the precipitation. Precipitation of this type is generally distributed evenly over a relatively large area and is of moderate intensity. Precipitation of this type accounts for about 50 percent of the total annual amount recorded at Butler Ranch. The other precipitation regime, which results from thunderstorm activity, commonly called convective storms is characterized by localized precipitation in moderate to severe intensities. The convective activity occurs from early June to late September.

Precipitation arising from convective activity is spatially highly variable. It is not uncommon for precipitation amounts from one storm to vary substantially over relatively short distances. However, this process can work both ways. One weather station may report a large amount of precipitation from one storm while the other one reports little. The converse can happen, resulting in similar long term climatic averages.

It is necessary to use weather stations with long-term climatic averages for analyzing precipitation. Butler Ranch, which is located on Huerfano River Parcel, has a long-term climatic record of about 25 years. Precipitation amounts can vary throughout the parcel, but variations in the long-term climatic averages will be slight.

Precipitation data recorded at the Butler Ranch, located a few miles northwest of the center of the study area, are presented in Table G-5. These data show the total precipitation at Butler Ranch averages 12.02 inches (30.53 cm) annually. Approximately two-thirds of the total precipitation normally falls during the five-month period of April through August. July is the wettest month with an average of 2.05 inches (5.21 cm), followed by May and August with 1.79 and 1.46 inches (4.55 and 3.74 cm), respectively. Precipitation is generally lightest in winter with January being the driest month. Daily precipitation amounts greater than or equal to 0.10 inch (0.25 cm) can be expected an average of 30 days per year at the Butler Ranch. Amounts greater than or equal to 0.50 inch (1.27 cm) can be expected an average of only 7 days per year (Table G-6).

Estimates of extreme precipitation that could occur in the study area are approximated by data from Pueblo which show a maximum 24-hour total of 3.77 inches (9.58 cm) and a maximum monthly total of 8.13 inches (20.65 cm) (U.S. Department of Commerce, 1976). Estimated return periods for short duration precipitation in the study area are presented in Table G-7.

Summer rain is most often produced by thunderstorms which occur on the average of 41 days per year (Table G-8). Precipitation in winter and early spring occurs mainly in the form of snow. From the Pueblo data, the greatest average monthly snowfall of 7.3 inches (18.5 cm) occurs in March with the next greatest amount, 5.5 inches (14.0 cm), falling in January. The annual mean total snowfall at Pueblo is 31.8 inches (80.8 cm). The greatest snowfall amounts recorded at Pueblo include a maximum 24-hour total of 16.8 inches (42.7 cm) and a monthly maximum of 29.3 inches (74.4 cm) (U.S. Department of Commerce, 1976).

Wind

Long-term summarized wind data are available from the Pueblo Memorial Airport. Although the data may be influenced to some degree by drainage flows in the Arkansas River Valley, they are the best available data near the study area and should be fairly representative of site conditions. The seasonal and annual wind roses for Pueblo are presented graphically in Figures 3-11 and 3-12, respectively. These data show that

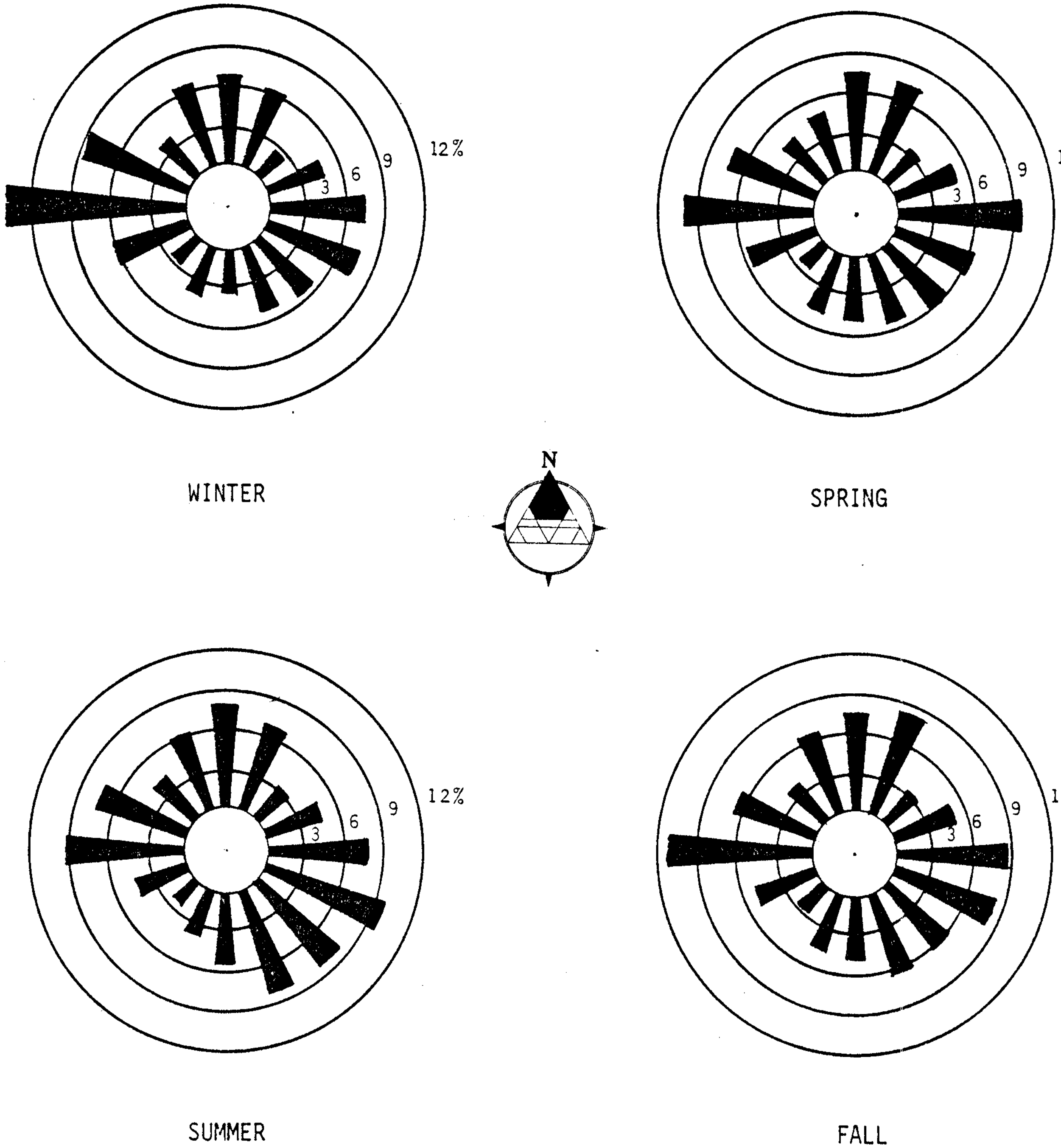


FIGURE 3-11

SEASON WIND ROSES
PUEBLO, COLORADO

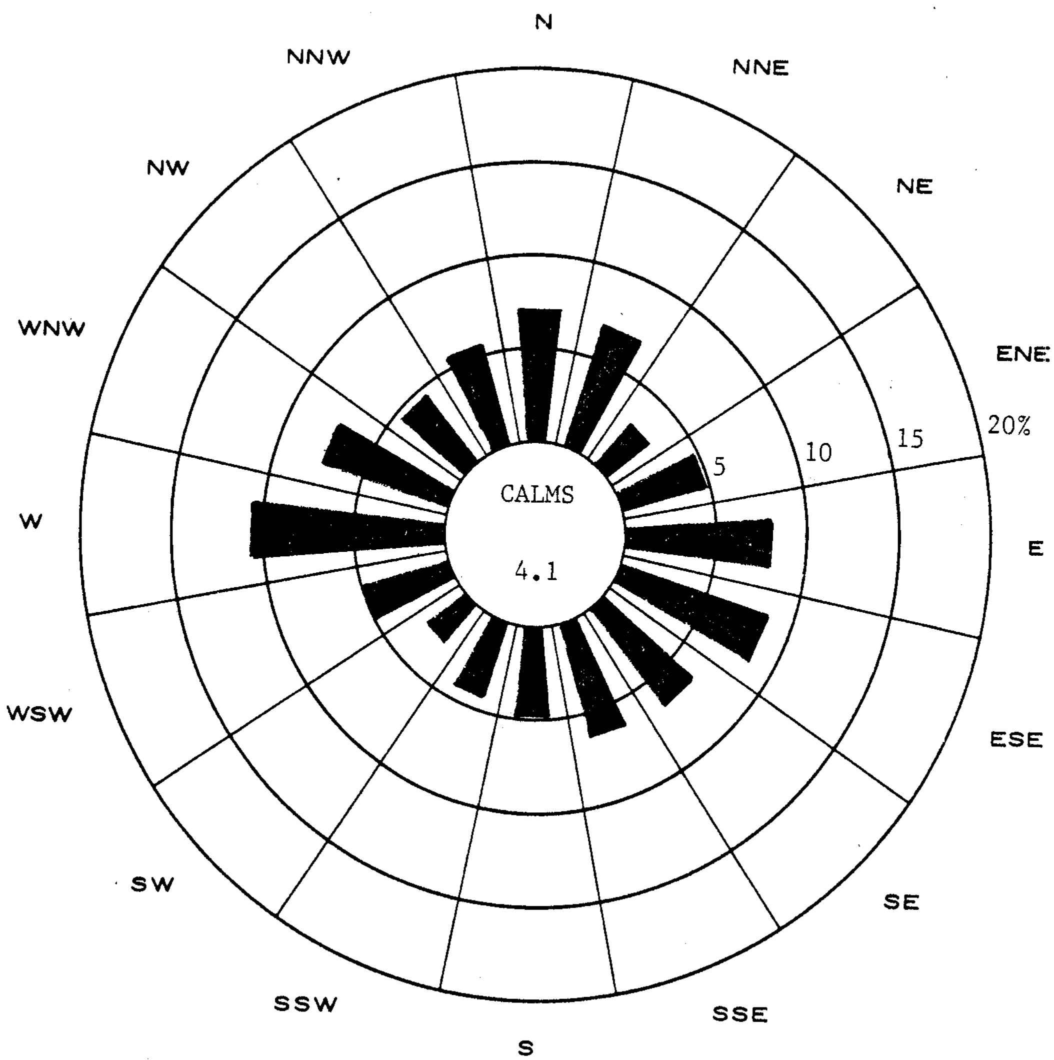


FIGURE 3-12

ANNUAL WIND ROSE
PUEBLO, COLORADO

the most prevalent wind direction is west, followed by east-southeast and east, while the most infrequent wind directions are southwest and northeast.

Average wind speeds by direction are also presented in Table G-9. These data show that the average annual wind speed is about 9.4 miles per hour (4.2 meters per second), with highest velocities associated with northerly (12.8 mph, or 5.7 mps) and north-northeasterly (12.3 mph, or 5.5 mps) winds. The lowest speeds are associated with winds out of the south-southwest and south.

Severe Weather

The most common forms of severe weather in the study area are associated with thunderstorm activity. Brief, but intense, thundershowers may result in the flash flooding of normally dry stream beds. Also, such storms may be accompanied by hail which may be large enough to cause damage.

Tornadoes have been reported in the general vicinity of the study area but tend to be small and of short duration. Based on a method developed by Thom (1963), the probability that a tornado would strike any given point in the study area is estimated to be on the order of 3×10^{-4} with a resultant estimated mean recurrence interval of 3,300 years.

Air Quality

The Huerfano River Parcel is located in Pueblo, Huerfano and Las Animas Counties, which are included in Colorado Air Quality Control Region (AQCR) 7. AQCRs are groups of counties which, for reasons of topography, meteorology, and other considerations, are treated as units for air pollution control. The federal ambient air quality standards presented in Table G-13 are the same in all AQCRs.

The state of Colorado promulgated ambient air quality standards for "designated" and "non-designated" areas in 1976. A "designated" area is one which has been classified by the state as having relatively high ambient air pollution levels to which less stringent air quality standards are applicable. A "non-designated" area is one with relatively clean air for which more stringent standards have been established (Table G-13). A vast majority of the parcel, the area included in Pueblo County, is in a designated area and is subject to the less stringent state standards. However, the small sections along the southern boundary that extend into Huerfano and Las Animas counties are in a non-designated area and are therefore subject to the stricter standards.

Colorado Air Pollution Control Commission and the U.S. Environmental Protection Agency have assigned priorities for controlling each major pollutant found in each AQCR. Pollutant priorities for the regions determine the amount and type of air pollution control program emphasis to be applied in each region. The priorities of the various pollutants in AQCR 7 are shown below: (A Priority I pollutant is of more concern in a given region than a Priority II or Priority III pollutant.)

Particulates	I
Sulfur Dioxide (SO_2)	III
Carbon monoxide (CO)	III
Nitrogen oxides (NO_x)	III
Hydrocarbons/oxidants (HC, O_x)	III

To assist in the management and control of particulates, the Colorado Health Department maintains air quality monitoring stations at the critical areas in the various AQCR's throughout the state. Several of these monitoring stations are located in the general vicinity of the Huerfano River Parcel. The stations are Rocky Ford, Pueblo Health Department, Pueblo at Mesa Drive and Evans, and Walsenburg. Summarized data from these monitoring stations are presented in Table G-12 in Appendix G.

The data shows that particulate concentrations have exceeded all state and Federal standards at each station except Walsenburg where Federal annual and 24-hour secondary standards and the state 24-hour standards were not violated (see Table G-11). It should be noted, however, that all of the high volume samplers are at urban locations which are biased by urban influences and do not represent conditions in rural areas.

The very small sections in the southern part of the parcel that are in Huerfano and Las Animas Counties would be subject to the standards for non-designated areas. The Colorado standards for these areas are a 24-hour maximum of 150 $\mu g/m^3$, not to be exceeded more than once in a 12-month period, and an annual arithmetic mean of 45 $\mu g/m^3$ (Table G-11). Total suspended particulate levels at all four of the locations in Table G-12 exceeded both of these standards in 1976, although of the four stations only Rocky Ford and Walsenburg would be subject to the standards for non-designated areas.

3.1.7 Sound

An ambient sound level survey was conducted at five locations on or near the Huerfano River Parcel area in order to document the existing ambient sound levels. Locations of the survey are shown on Figure 3-13. Details of the survey and results are described in Appendix H.

Ambient sound levels at nearby noise sensitive land use areas are typical of small communities and towns. Noise levels in these areas are dominated by two major noise sources: traffic and community activities. Both of these noise sources are more predominant in the

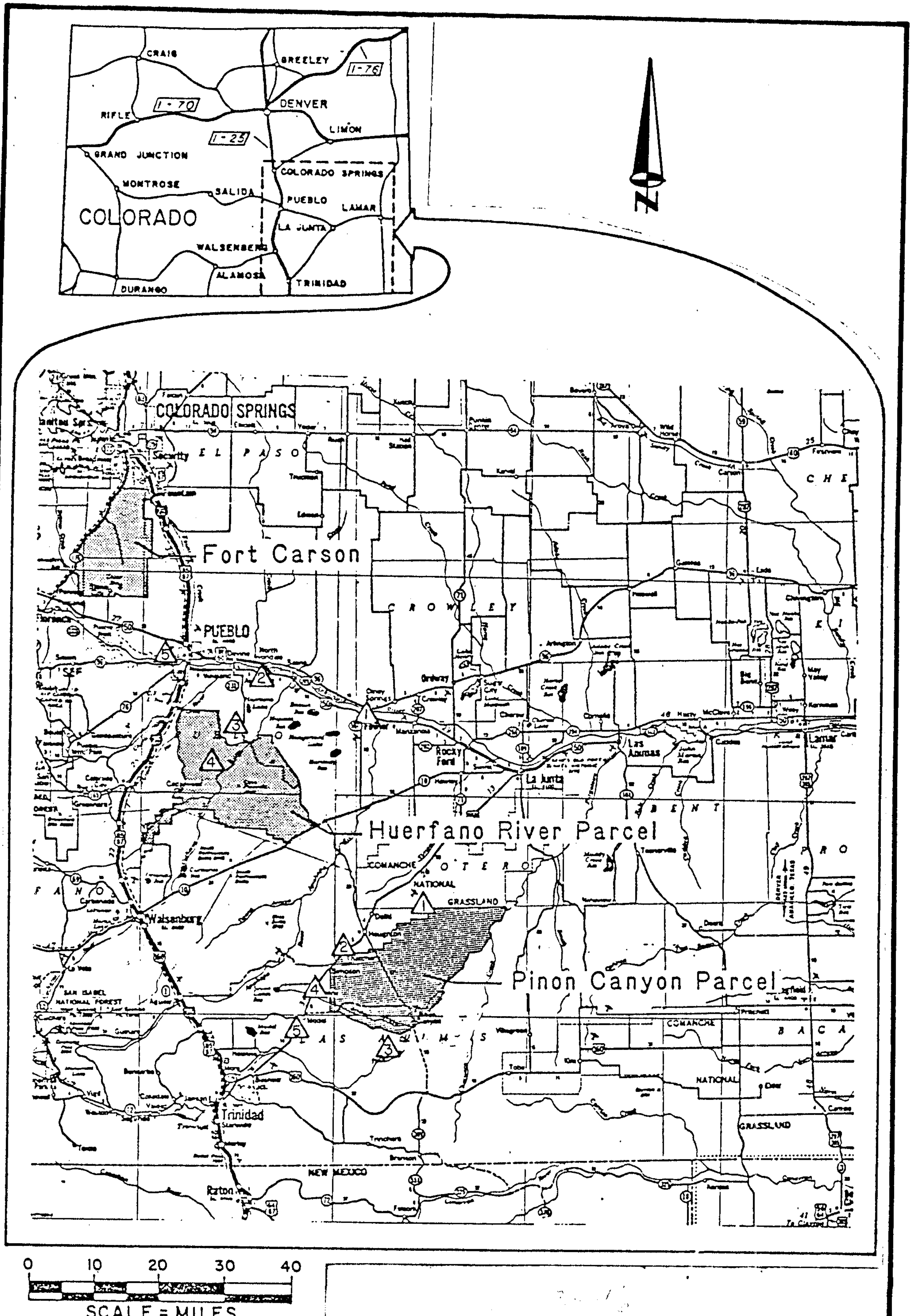


FIGURE 3-13 AMBIENT SOUND SURVEY MEASUREMENT LOCATIONS

DAMES & MOORE

daytime than during nighttime hours. Wind, domestic animals and occasional overflying planes also contribute to the ambient sounds. A statistical summary of the ambient sound level measurements is presented in Table 3-11. Note that the present ambient day-night sound levels (L_{dn}) are below 55dB, the level suggested by the U.S. Environmental Protection Agency as requisite to protect the public health and welfare.

3.1.8 Socioeconomics and Land Use

Population/Demography

The Spanish Peaks Region is comprised of Pueblo, Las Animas and Huerfano Counties. Except for Pueblo County, the region has experienced a slowly declining population since the 1920s when the gradual closing of coal mines removed the major industry and employment source for the region. Between 1970 and 1977 the downward trend in population and economic growth slowed; Huerfano had only a 0.4 percent decline and Las Animas gained by almost 1 percent. Pueblo County has continued to experience population growth, with a 4.4 percent increase during the same period. Additional information on the socioeconomic aspects of this region is included on the tables in Appendix I.

Population density for Pueblo County is 50.8 people per square mile compared with an average of 25.7 for the state. This higher average is due to the dense population in the city and along the Arkansas River valley. Huerfano and Las Animas counties are very sparsely populated, with 4.0 and 3.3 persons per square mile respectively. The area included in the proposed parcel has a very low population density, estimated to be 1 person per 10 square miles.

The city of Pueblo dominates the region in terms of economic activity and population. Pueblo County contains about 85 percent of the region's population with 70 percent of the entire area population residing in the city of Pueblo. At an estimated 122,500 present population, Pueblo County has experienced increases and decreases in population since the 1970 census, resulting in a net increase of 4.4 percent between 1970 and 1979. A range of population figures for the three counties and the state is indicated in Appendix I (Tables I-1, I-2 and I-3).

The median ages are high for Las Animas and Huerfano Counties with medians of 32 and 35.5 respectively compared with the Colorado median age of 26.2 (Table I-4). Pueblo is closer to the state average with a median age of 27.0. The relatively low birth rate and significantly higher death rate probably will continue to contribute to the low rate of population growth in Huerfano and Las Animas Counties.

Population projections were developed by the demographic research group in Colorado's Department of Local Affairs (Table I-2). These are based on the 1970 census data and projected population levels through 1990. The projections for Huerfano County range from a 13 percent loss

TABLE 3-11

SUMMARY OF AMBIENT SOUND LEVELS
(WEEKDAYS)

Locations	Daytime (0700-2200)	Nighttime (2200-0700)	
1	05/19/77 1600	05/19/77 2240	
L_{90}	40	30	
L_{50}	46	38	
L_{10}	50	45	
L_{eq}	47.5	43.0	
L_d			47.5
L_n			43.0
L_{dn}			50.4
2	05/19/77 1705	05/19/77 2335	
L_{90}	42	38	
L_{50}	46	41	
L_{10}	52	46	
L_{eq}	52.6	44.2	
L_d			52.6
L_n			44.2
L_{dn}			53.2
3	05/19/77 1835	05/20/77 0125	
L_{90}	38	18	
L_{50}	43	20	
L_{10}	48	31	
L_{eq}	46.6	30.0	
L_d			46.6
L_n			30.0
L_{dn}			45.0
4	05/19/77 1920	05/20/77 0045	
L_{90}	24	17	
L_{50}	26	17	
L_{10}	46	18	
L_{eq}	40.7	18.0	
L_d			40.7
L_n			18.0
L_{dn}			38.7
5	05/19/77 1420	05/19/77 0100	
L_{90}	42	31	
L_{50}	45	36	
L_{10}	50	43	
L_{eq}	48	44.1	
L_d			48.0
L_n			44.1
L_{dn}			47.0

in population to a possible 17 percent increase. The range for Las Animas County is between a 15 percent decline and a 0.01 percent increase. Pueblo County has a projected range between a 6.5 percent loss and a 9 percent increase. The population of the state as a whole is projected to increase between 24 and 48 percent by 1990.

Economic Base

The three counties of the Spanish Peaks Region together have a relatively well balanced economy, although each county has distinctive economic characteristics. The numbers of persons and percentages employed in each industry are indicated on Table I-5. For all counties, government leads as the major employer with approximately 33 percent, followed by the trade and services categories.

Pueblo continues to lead the region in financial and commercial activity with 78.7 percent of the retail sales for all three counties centered in the city (Table I-6). Pueblo County has 14.4 percent of the retail sales, where figures for Las Animas County and Trinidad are 5.1 and 4.5 percent respectively, while Huerfano County contributes about 2 percent to the total. This represents a slight decrease in sales between 1978 and 1979 (University of Colorado, Business Research Division, 1979).

Manufacturing is a major employment source for Pueblo, and the city contributes 81 percent of the manufacturing enterprises in the region (Table I-7). The 1979 figures represent a slight decrease from 1976 figures (University of Colorado, Business Research Division, 1979). Las Animas County has 18 percent of the region's manufacturing, of which 13 percent is concentrated in Trinidad. Huerfano County and Walsenburg contribute the remaining 1 percent to the total.

Agriculture remains an important aspect of the overall economy in the region. The importance of agriculture to the economy of Pueblo County tends to be dominated by higher value industrial and trade activities. By contrast, the major economic activity and predominant culture of Las Animas and Huerfano Counties is farming and ranching. In both Las Animas and Huerfano counties close to 88 percent of the land is devoted to agricultural use, primarily cattle ranching (Huerfano-Las Animas Council of Governments, 1979). As of January 1, 1979 the combined cattle inventory of the three counties represented 4 percent of the state total of 3.09 million cattle, down slightly from 1978 figures (Colorado Department of Agriculture, 1979) (Table I-8).

Southern Pueblo County, where the Huerfano parcel is located, more closely resembles Huerfano and Las Animas Counties in landscape and economic aspects. The parcel area is presently used almost exclusively for grazing. It is estimated that the parcel area could support between 3750 and 5625 cattle during a year period depending on moisture and grass availability. These animals would be worth between 2.8 and 4.2 million dollars based on a market weight of 1000 pounds at $75.00 per hundred weight.

The productivity of these animals is worth between 0.9 and 1.97 million dollars annually, depending on such variables as markets, weather and forage availability. This estimate is based on grazing carrying capacity of 40 acres per animal unit (representing actual practice in Pueblo County and in the parcel area) and 60 acres per unit (recommended for range conservation in the area), with an average 80 percent calf crop for between 3000 and 4500 calves. The average market value per calf is $300 to $350 when sold to feeder operations.

In addition to livestock, which includes cattle, dairying, hog and sheep raising activities, a variety of crops is produced in this region. The 1978 total crop value from these three counties contributed 1.8 percent of the total crop values for the state, representing continuing increases in this area over previous years (Table I-9).

A variety of mineral resources is produced in the Spanish Peaks Region, though this does not represent a major portion of the economic output for the area. No minerals are produced on or near the parcel; however there is a large limestone deposit in the northwest corner of the parcel which is currently under exploration (see Section 3.1.1). Locations of lands leased for limestone exploration are shown in Figure 3-1.

For 1977, the per capita personal income of residents of Pueblo, $6,654; Las Animas, $4,682; and Huerfano Counties, $4,458; is lower than the state average, $7,166 (Table I-10). Unemployment rates were between 1 and 2.4 percent higher than the average for the state during 1979. The 56,000 available jobs in the region represented 4.2 percent of the total number of jobs available in the state (Table I-11).

The total assessed valuation of the three counties in the Spanish Peaks Region is $540.4 million, (Table I-12), ranging from a high in Pueblo of $468.5 million to a low of $24.8 million for Huerfano. Total revenue recognized from total property tax levies was as follows: Pueblo $34.4 million; Las Animas $3.2 million; Huerfano $1.8 million for a total of $39.4 million in the three county region in 1978 (Colorado Division of Property Taxation, 1978).

The portion of these counties included in the parcel represents a total annual revenue of $88,652 to Pueblo County; $1,744 to Las Animas County and $989 to Huerfano County, a total of $91,385. This is .25% of the annual revenue for this area, and is based on the assessed valuation of agricultural land.

Land Use Aspects - Parcel & Surrounding Area

The proposed Huerfano River Parcel is located primarily in southeastern Pueblo County with small extensions into Huerfano and Las Animas Counties. The site, encompassing 224,976 acres (91,048 hectares) of grazing land, is located about 35 miles from Pueblo and Walsenburg and 60 miles from Fort Carson. Pueblo County contains about 211,076 acres

(85,422 hectares) with 4,300 acres (1,740 hectares) in Huerfano County and 9,600 acres (3,885 hectares) in Las Animas County. The proposed cantonment site is at Cedarwood where there is a rail siding for the Denver and Rio Grande Western railroad. The area is also served by the Cedarwood Exit (#77) from Interstate 25.

The areas directly contiguous to this parcel are used for grazing. However, along the eastern edge of the parcel, there is a strip of irrigated and dry cropland mixed with the grazing land. To the north within a few miles of the parcel border is an area of low density residential land use occupied by fairly expensive homes. Southeast Pueblo which is about 5 miles (2.0 km) from the proposed boundary is expanding in the direction of the parcel and is the closest population center. No other residential areas are within 8 miles (13 km) of the parcel boundary.

The predominant land use in the three-county area, and within the parcels is rangeland/grazing (Figure 3-14) (Table I-13 in Appendix I). Urbanized land uses comprise a relatively small proportion of overall use categories in these sparsely settled counties. There is no urban land use on or near the parcel.

Land in the parcels is primarily privately owned, with scattered areas of state and Federal ownership (Figure 3-15).

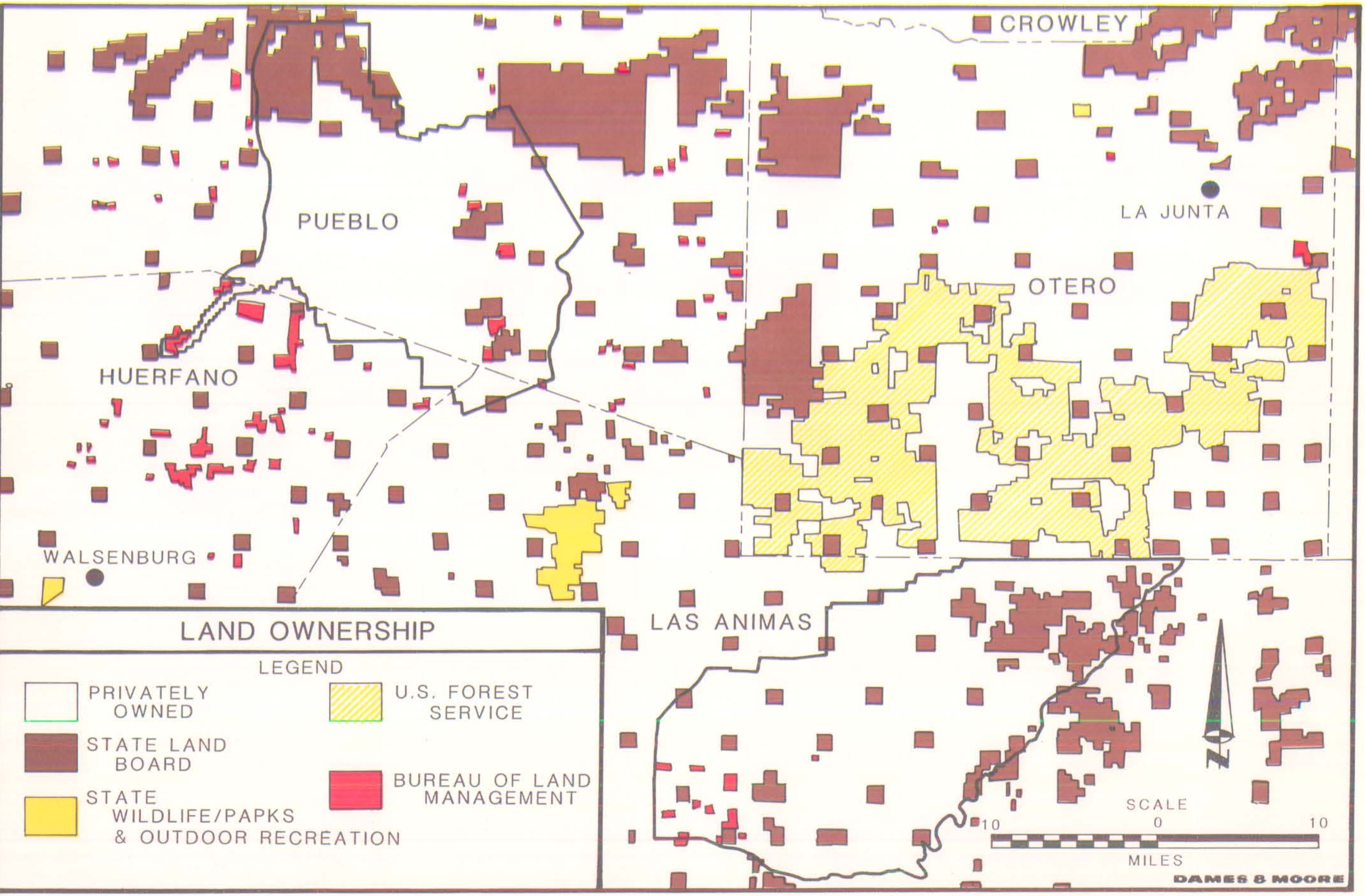
Existing Transportation Facilities

The primary transportation route between Fort Carson and the Huerfano River Parcel is Interstate 25 (I-25) to the Cedarwood exit. As an alternate route, military convoys could use U.S. 50 east from Pueblo and then to Doyle Road and south to the parcel. Another possible route would be to follow I-25 south to Walsenburg and to turn northeast on Colorado Highway 10 with access to the parcel via the Red Top Ranch Trail. Railroad facilities are available on the Colorado and Southern/ Denver and Rio Grande Western tracks which run north-south roughly parallel to I-25. Alternative railroad service is available on the A.T. and S.F. tracks which extend east from Pueblo and southwest from La Junta to Trinidad.

3.1.9 Cultural Resources

Historic, archaeological and cultural aspects of the proposed Huerfano River parcel are important features of the site. There is copious evidence of the existence of early and recent Indian activity in the Huerfano River and Cucharas River canyons. Petroglyphs, pictographs, chipping stations, stone structures and other evidence of early man sites are abundant in the area.

Professional archaeologists have long recognized that the area contains much cultural material. A group of highly competent amateur


CROWLEY
LA JUNTA
OTERO
PUEBLO
HUERFANO
WALSENBURG
LAS ANIMAS
LAND OWNERSHIP
LEGEND
PRIVATELY OWNED
STATE LAND BOARD
STATE WILDLIFE/PAPKS & OUTDOOR RECREATION
U.S. FOREST SERVICE
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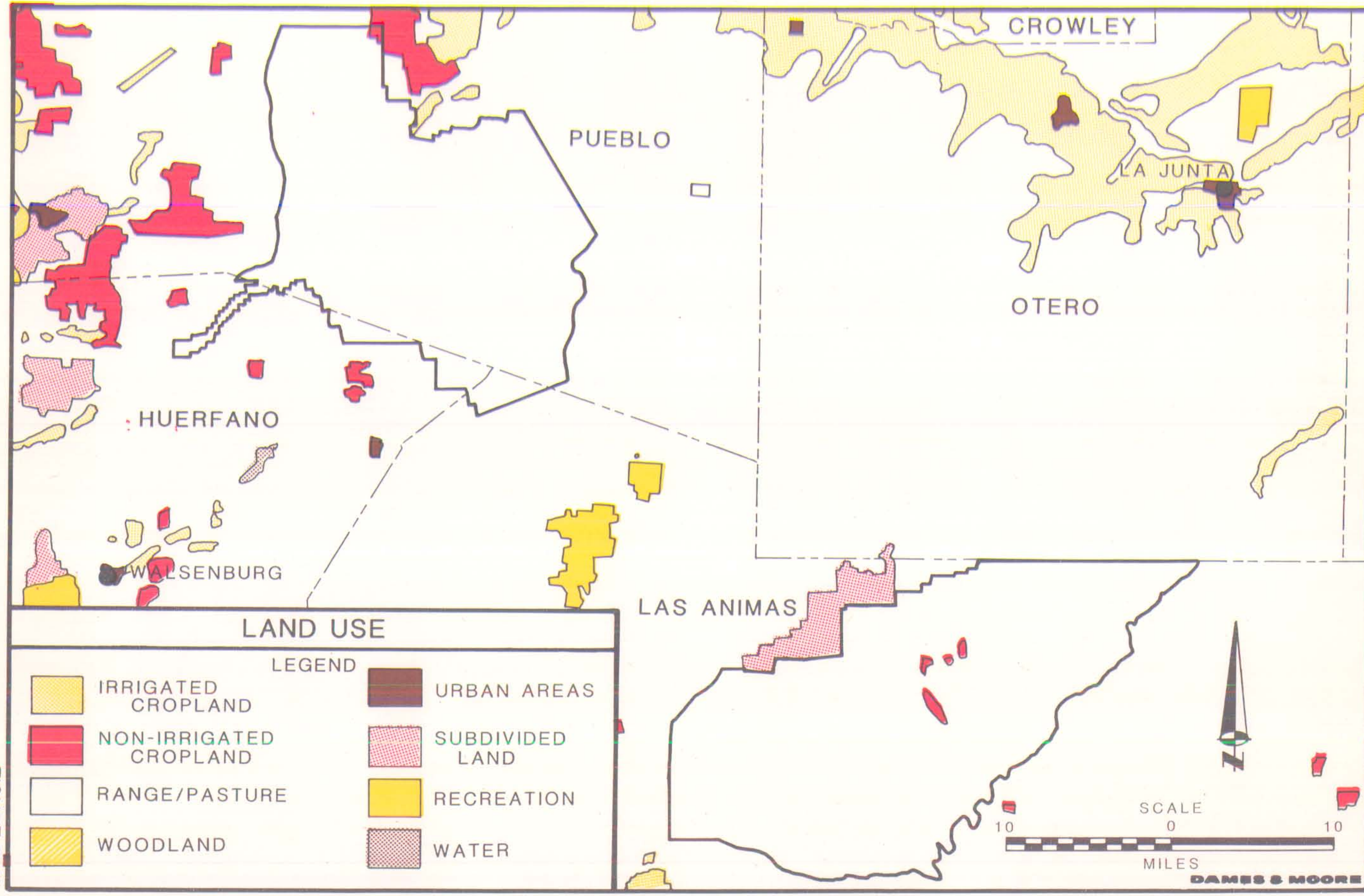

CROWLEY
PUEBLO
LA JUNTA
OTERO
HUERFANO
WALSENBURG
LAS ANIMAS
LAND USE
LEGEND
IRRIGATED CROPLAND
NON-IRRIGATED CROPLAND
RANGE/PASTURE
WOODLAND
URBAN AREAS
SUBDIVIDED LAND
RECREATION
WATER
SCALE
10 0 10
MILES
N
DAMES & MOORE

FIGURE 3-14

archaeologists is currently conducting a detailed inventory in the canyon area. This inventory will be submitted to the state and added to the official records (Personal communication, Julia Avery, February 20, 1980).

The State Archaeologist's files show many sites in Las Animas, Huerfano and Pueblo Counties. Few have been identified on the lands proposed for Army acquisition, since the state emphasizes sites on public lands primarily and the parcel includes extensive private land holdings. Amateur archaeologists have identified between 150 and 180 sites in the Huerfano River Canyon and tributaries and on the uplands around the canyons in the area. A list of approximate locations and numbers of sites is included on Table 3-12 (Personal communication, Don Winters, amateur archaeologist, April 10, 1980). In addition to the canyons, uplands locations on the Red Top Ranch in the eastern part of the parcel have been discovered to have a similar wealth of artifacts. A master's thesis was prepared at Colorado College during the 1970s based on this area (Anderson, 1972). The discovery of artifacts throughout the parcel gives an indication of the extent of early man's activity in the area. More exact descriptions of locations for archaeological and historic sites are not available from public or private information sources such as the State Archaeologist's files, the State Historical Society or knowledgeable citizens, in order to protect the resources.

The Colorado Natural Areas Program (CNAP) has proposed that the Huerfano and Cucharas Canyons areas be placed on the state registry of natural areas. The area meets the scientific criteria for a State Natural Area and would be put on high priority status to be considered for designation as such. The proposed boundaries of the natural area, as presented in the sketch map (Figure 3-16) coincide closely with the boundaries which have been included in the non-use buffer zone in this parcel.

Sites of historical significance located on or near the Huerfano River Parcel include Trappers Trail, Barlow and Sanderson Stage Line, the Long Expedition, the Villasur Expedition, and Fremont's Expedition. These sites have not been included in the National Register of Historic Places, but have been designated by the State Historical Society of Colorado as potentially eligible for inclusion in the National Register. The approximate locations of these historic routes are included on Table 3-12. Generally, the trails cross the parcel completely, though there is little evidence of their original passages remaining on the Huerfano River Parcel.

TABLE 3-12

ARCHAEOLOGICAL AND RECENT HISTORIC SITES - HUERFANO RIVER PARCEL VICINITY

ARCHAEOLOGICAL SITES:

Source: State Archaeologist's Files

Huerfano County:

T25S, R64W - 4 sites
T26S, R64W - 5 sites

Pueblo County:

T22S, R65W - 2 sites

Las Animas County:

None listed near parcel

Source: Don Winters, Amateur Archaeologist, 10 April 1980

Approximate Number of Sites, by Canyon Reach:

Huerfano River Canyon to Cedarwood Canyon	5
Cedarwood Canyon	3-4
Unnamed Canyon, West Branch, Cucharas River	10-12
Cucharas Canyon, near "The Island"	Several Possible
Estic	8-10
Sheep Canyon	10
Doe Canyon	5
West Turkey, East Turkey and Cat Canyons	3-4 each
Poleline Canyon	5
Little Joe Canyon (past flooding, so much has been covered by silt)	5
Horse Thief Canyon (three branches)	12
Karrick Canyon	12-20
Horse Pasture Canyon	12
Hog Ranch Canyon	5
Doyle Arroyo	20
Peterson Canyon	5
Dime Spring (Ten-Cent Waters)	3-4
Turkey Ridge (Uplands)	25+
Black Ridge (Uplands)	20+

TABLE 3-12 (Concluded)

RECENT HISTORIC SITES:

Source: Colorado Inventory of Historic Sites, Oct. 1976

Huerfano County:	
Trapper's Trail	T25-28S, R65-70W, Many Sections
Villasur Expedition (Ca 1720)	T25-29S, R65-66W
Barlow and Sanderson Stageline	T25-29S, R55-70W, Many Sections
Pueblo County:	
Trapper's Trail	T18-25S, R64-65W, Many Sections
Villasur Expedition	No Township and Range given
Barlow and Sanderson Stageline	T20-25S, R64W, Many Sections
Long Expedition	T18-25S, R60-65W, Many Sections
Las Animas County	
Long Expedition	T26-35S, R59-61W, Many Sections

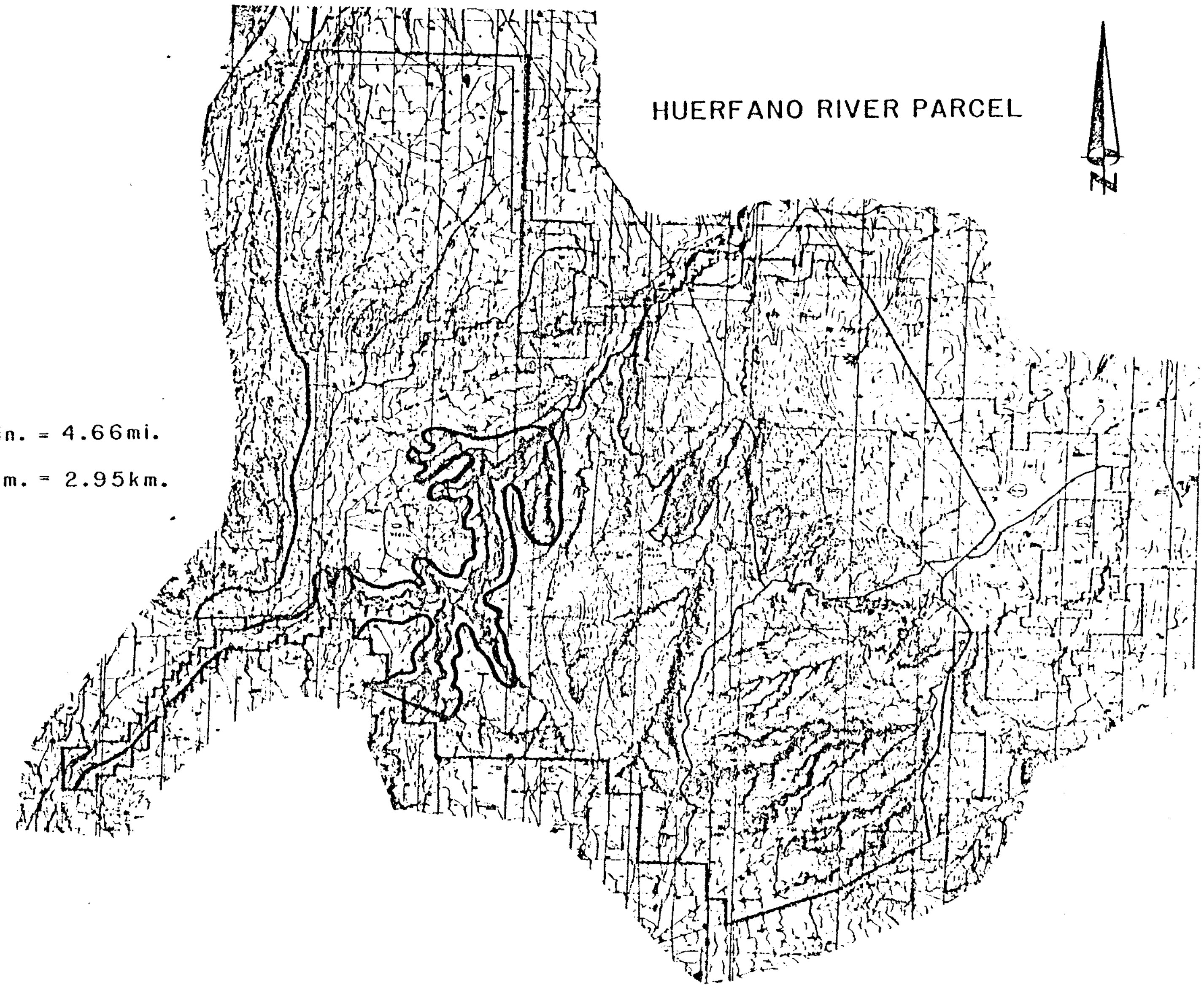


FIGURE 3-16 PROPOSED COLORADO NATURAL AREA

3.2 PINON CANYON PARCEL

The affected environment of the Pinon Canyon Parcel includes the existing environmental characteristics of the parcel. The following summaries of baseline conditions are supplemented by more detailed data in the Appendices.

3.2.1 Geology/Mineral Resources

Topography and Physiography

The Pinon Canyon Parcel lies at the margin between the Colorado Piedmont and the Raton Sections of the Great Plains Physiographic Province. The northern edge of the Raton Section has relatively high altitudes and deep canyons, with well-developed cliffs along major rivers, while the Colorado Piedmont exhibits more moderate topography. In general, the areas less than 5000 feet (1524 m) above mean sea level (msl) in the parcel exhibit the steep topography and deep canyons characteristic of the Raton Section while those above this altitude are Piedmont in nature.

The topography of the parcel consists of a broad, moderately sloping upland bordered on all sides by major topographic features. The northeast edge of the site is bounded by the deep canyon of the Purgatoire River; the Big Arroyo and Bear Springs Hills form the western edge of the parcel. A prominent hogback formed by the Dakota Formation cuts across the southern margin of the parcel.

The highest point in the parcel is at the northwestern boundary at an elevation of over 5700 feet (1737 m) msl. The lowest point lies in the valley of the Purgatoire River where it leaves the parcel at an elevation of less than 4300 feet (1311 m) msl. Elevations generally slope east and southeast toward the Purgatoire River except in the northwest portion of the parcel where the slope is to the north and west.

The Purgatoire River Canyon, which forms the eastern boundary of the parcel, is the dominant topographic feature in the area. This narrow, steep-walled canyon exhibits local relief of over 450 feet (137 m) in some areas. The majority of the parcel is drained by the Purgatoire River which flows northeast through this canyon. Drainage is controlled by the east and southeast gradient ranging from 50 to 100 feet per mile (10 to 20 m/km). Big Arroyo in the northwest corner drains north into Timpas Creek. Both of these watercourses are tributary to the Arkansas River to the north.

Geology

The Pinon Canyon Parcel lies adjacent to the Apishapa Uplift, a gentle positive structure which separates the Raton Basin to the southwest from the Denver-Julesburg Basin which lies to the northeast. The parcel is underlain by a relatively thin cover of sedimentary rocks overlying the Precambrian basement. A more complete discussion of the subsurface geology is included in Section 3.2.4.

The bedrock units outcropping at the surface range from Upper Cretaceous Niobrara Formation in the northern and western portions to Permian age Taloga Formation, Dry Creek Dolomite, and Whitehorse Sandstone in the Purgatoire River Valley in the eastern edge of the parcel. A Tertiary dike of intrusive igneous rock cuts through these sediments in the extreme southern portion of the parcel. Scattered Quaternary alluvium overlays the bedrock in the Purgatoire River Valley and small areas of Quaternary dune sands are present in the south-central area of the parcel.

The greatest percentage of the outcrop is the Benton Group, Dakota Sandstone, and the Purgatoire Formation. Units of minor importance are alluvial deposits, dune sand, Niobrara Formation, Fort Hays Limestone, Morrison Formation, Ralston Creek Formation, Entrada Sandstone, Dockum Group, Taloga Formation, Day Creek Dolomite, and Whitehorse Sandstone. One system of Tertiary basalt dikes cuts through Van Bremer Arroyo in the extreme southern boundary of the parcel.

The Benton Group can be subdivided into three formations: the Carlile Shale, Greenhorn Limestone, and Graneros Shale. These formations cover much of the northern and western portions of the Pinon Canyon Parcel. These formations have a generally low relief and form few ledges. The Dakota Sandstone crops out throughout the eastern and southern portions of the parcel above the Purgatoire River and in the small tributaries to the river. The Purgatoire Formation consists of two members, the Kiowa Shale and Cheyenne Sandstone, and it underlies the Dakota in the areas described.

The Niobrara Formation, represented by the Fort Hays Limestone member, crops out along the northern and western edges of the parcel. The Fort Hays Limestone forms prominent ledges in the outcrop area.

The remainder of the bedrock units crop out in limited areas in the parcel. The Morrison Formation, Ralston Creek Formation, and Entrada Sandstone crop out in the Purgatoire River Valley and canyon walls and in the major arroyos. These units consist predominantly of shale and sandstone. The Triassic Dockum Group consists of sandstone and siltstone and is found only in the Purgatoire Canyon and its major tributary from the south, Chacuaco Creek. The Taloga Formation Siltstone, Dry Creek Dolomite, and Whitehorse Sandstone are also found only in this area and have a limited areal extent.

The geologic structures of the Pinon Canyon Parcel are generally associated with the Apishapa Uplift which trends southeast to northwest across the southern area of the parcel. These sedimentary rocks dip generally northeastward 1 to 3 degrees but can be up to 36 degrees in local areas. Small faults associated with the uplift are present in the northern edge of the parcel. The major smaller structure within the parcel is the Black Hills Monocline and two associated structures, the Sheep Canyon and Muddy Creek Monoclines. Several smaller synclines and anticlines are also associated with these monoclines, including the Model Anticline in the western portion of the parcel.

A 60,000-acre (24,282 hectares) area included within the eastern boundary of the Pinon Canyon Parcel along the Purgatoire has been considered for National Natural Landmark designation by the U.S. Department of the Interior and proposed as a possible park by the State of Colorado, (as shown on Figure 3-17) (Schaffeld, 1977; Welch, 1977). This interest has been generated by "Redrocks" geology exposed in the area. Steep cliffs have been cut by the Purgatoire River and its tributaries exposing several brightly-colored geologic units. The exposures of the bright red sandstone and shales ranging in age from Permian to early Cretaceous are the main scenic attraction. Several other geologic features including well-exposed stratigraphy, highly visible geologic structures and youthful geomorphology have been cited as justification for including the site in the National Registry of Natural Landmarks (Heritage Conservation and Recreation Service, no date).

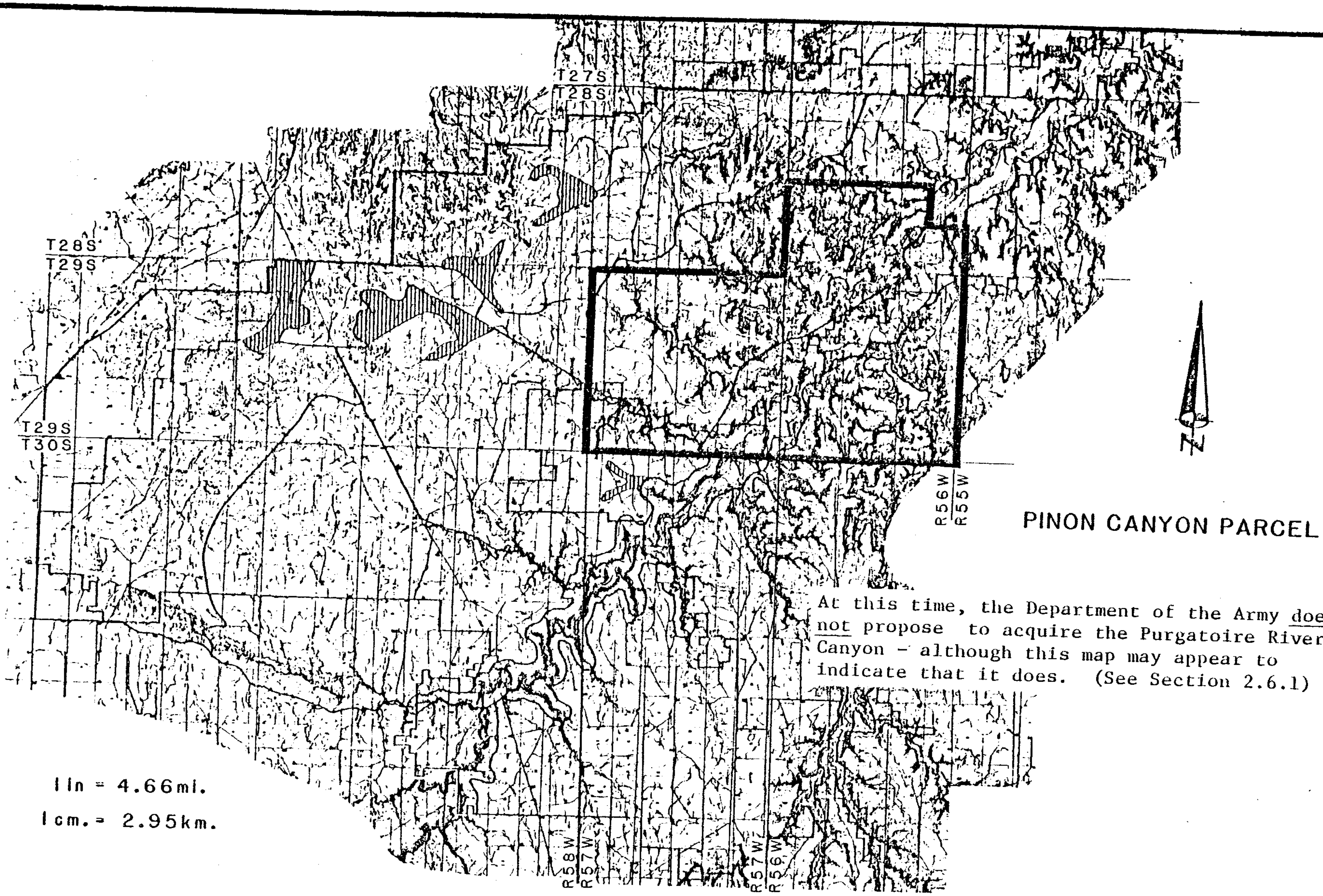
Geologic Hazards

Numerous landslide deposits have been identified in the Morrison Formation along the Purgatoire River Canyon (Colton, 1975). The landslides are probably caused by oversteepened topography due to river downcutting and subsequent failure in the weaker shale and claystone layers of the Morrison Formation. Landslide deposits were also noted in the Benton Group along Van Bremer Arroyo. Potential slope stability problems can be expected in both of these areas.

Summary of Mineral Potential

Based on evaluation of the mineral and energy resource potential of the Pinon Canyon Parcel, Colorado School of Mines Research Institute (CSMRI) (1980) concluded that, "With the possible exception of uranium, no potentially economic deposits of leasable, locatable, or saleable minerals or fuels are known to exist on or in close proximity to the Pinon Canyon Parcel. There is a remote possibility that commercial deposits of uranium exist under the Pinon Canyon Parcel in sandstones of the Lower Cretaceous Purgatoire Formation, which appears in this area to possess favorable characteristics for the concentration of uranium ore." However, no exploration activity for uranium or any other mineral was noted by CSMRI in the Pinon Canyon area.

The Model Dome helium field is located in the western part of the Pinon Canyon Parcel in parts of T29S, R60W and T30S, R60W. During seven months of production in 1929 and 1930, the field produced 53,152,000 cubic feet of gas from the Permian Lyons Sandstone. The produced gas



At this time, the Department of the Army does not propose to acquire the Purgatoire River Canyon - although this map may appear to indicate that it does. (See Section 2.6.1)

FIGURE 3-17 PROPOSED RED ROCKS CANYON NATIONAL NATURAL LANDMARK analyzed 8.1 percent helium, 15.7 percent carbon dioxide, 75.3 percent nitrogen, 0.7 percent argon, and 0.2 percent propane, with a very low heating value of 5 Btu (CSMRI, 1980).

The Bureau of Mines estimates that Model Dome contains 874 million ft^3 of gas at an extremely low reservoir pressure of 23 psi. With a helium content of 8.1 percent, this represents about 71 million ft^3 of helium gas reserve.

In 1930, the U.S. government purchased the property and shut in the wells as a reserve for future needs. "According to the U.S. Bureau of Mines, Amarillo, Texas (personal communication) the Model Dome is no longer considered to be a commercial source of helium" (CSMRI).

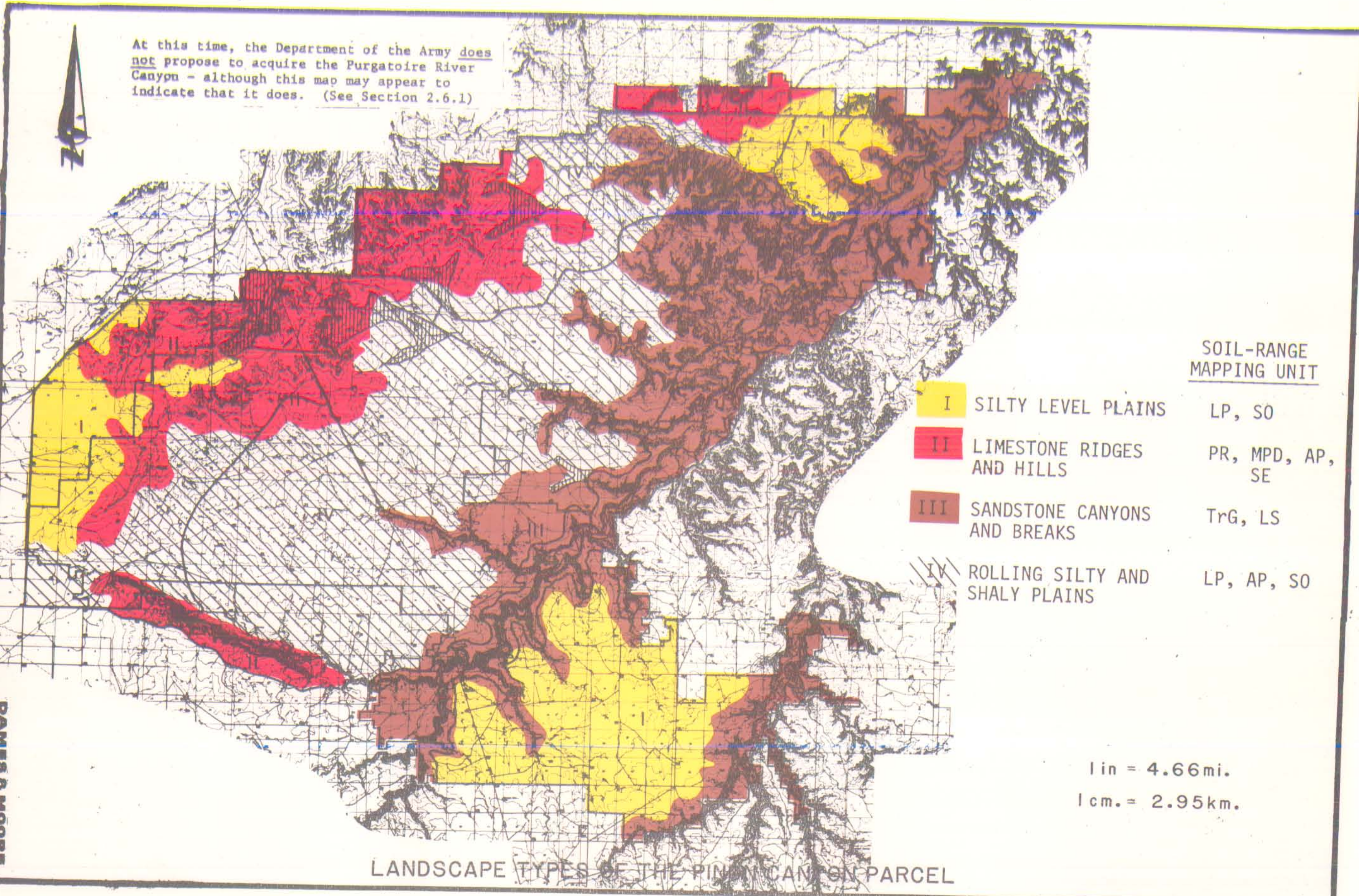
A detailed discussion of mineral resources is in Appendix B.

3.2.2 Soils

The Pinon Canyon Parcel contains four major landscape types, as shown on Figure 3-18. Each landscape type has a characteristic pattern of soils as described briefly below. Maps of the management units are included in Appendix A. Detailed descriptions of the mapping units and range sites are included in Appendices C and D.

The first landscape type, located in the west part of the parcel is dominated by a flat to gently sloping plain. The soils in this position are formed in wind-deposited silts with occasional small ridges of limestone outcropping in some areas. They are generally silty, weakly developed soils that are calcareous throughout. One small area of sand dunes crosses this landscape type midway. The mapping units dominating this landscape are LP (Loamy Plains) on the upland flats, SO (Saline Overflow) in depressions and along intermittent drainages, and SaP (Sandy Plains) in the sand dunes. This landscape type generally has a medium stability rating (Section 2.4) and will experience moderate soil losses by water erosion and high soil losses by wind erosion if disturbed.

The second major landscape type is composed of limestone ridges which cross the northwest corner of the parcel and form a small divide oriented to the south in the western portion of the parcel. The Bear Springs Hills are the most notable feature in this landscape area. The soils are commonly stone-covered with limestone at 20 inches (51 cm) or less in areas supporting stands of Pinyon pines and One-seed Junipers and silty soils with limestone at 30 inches (76 cm) or more in gently rolling grassy areas. The soils in this landscape type are generally all weakly developed, silty soils which are calcareous to the surface, and contain low amounts of organic matter. The major mapping units in the area are PR (Limestone Breaks-Pinyon-Juniper) and MPD (Loamy Plains-Limestone Breaks) with AP (Alkaline Plains) on steep sideslopes, and SO (Saline Overflow, eroded) along intermittent drainages. This landscape type generally has a low stability rating and will experience high soil losses by water erosion and moderate soil losses by wind erosion if disturbed.



LANDSCAPE TYPES OF THE PINON CANYON PARCEL

The third major landscape type occurs between the limestone ridges and the Purgatoire River. It is composed of a wide valley which crosses the parcel from southwest to northeast. The soils in this type range from silty soils in flat areas which are formed in a thin layer of wind-deposited silt to clayey soils formed in weathered shale in broad concave areas. Soils adjacent to intermittent drainages range from deep medium textured soils in areas where soil has been deposited by water to shallow soils formed directly on shale at the heads of drainages where downcutting into the shale has occurred. The major mapping units found in this landscape type are LP (Loamy Plains), AP (Alkaline Plains), SO (Saline Overflow) and SE (Saline Overflow, eroded). The stability rating in this landscape type ranges from medium to low. The soils will experience moderate water erosion losses in most mapping units and moderate to high wind erosion rates if disturbed.

The fourth landscape type occurs where the canyons of the Purgatoire River and associated side canyons form a series of steep rock-strewn cliffs and rolling mesa tops. The steepest portions of the canyons contain cliffs and stony soils with dark colored noncalcareous surface layers, while associated rolling hillslopes have moderately deep silty soils with noncalcareous surface layers and some areas of stony soils and sandstone outcrops. The mapping units occurring in this area are TrG (Pinyon-Juniper-Rockland) and LS (Loamy Plains-Sandstone Breaks) predominantly, with some areas of LP (Loamy Plains), SO (Saline Overflow) and SM (Salt Meadow). This landscape type has a medium stability rating in gently sloping areas and a low stability rating in steep areas. Water erosion rates range from moderate in gently sloping areas to very high in steep areas, and wind erosion losses will be low on almost all soils of this type if disturbed.

Management Unit F, due to limited access considered as an alternative unit for Reserve use under the Increased Use Scenario, is composed of sandstone canyons and open plains and is dominated by the LP, LS and TrG units similar to the fourth landscape type.

In all, ten soil-range mapping units were recognized on the parcel and are listed in Table 3-13.

TABLE 3-13

SOIL-RANGE MAPPING UNITS OF THE PINON CANYON PARCEL

Mapping Unit Symbol	Range Site Components
LP	Loamy Plains
LS	Loamy Plains - Sandstone Breaks Complex
PR	Limestone Breaks - Pinyon-Juniper Complex
MPD	Loamy Plains - Limestone Breaks Complex
SO	Saline Overflow

TABLE 3-13 (Continued)

TrG	Pinyon - Juniper - Rockland Complex
AP	Alkaline Plains
SE	Saline overflow, eroded
SaP	Sandy plains
SM	Salt Meadow

Table 3-14 summarizes the soil and vegetation characteristics of each mapping unit described on the Pinon Canyon Parcel. Detailed descriptions of mapping units and range site component percentages of each are contained in Appendix C.

Soil Erodibility Characteristics

The erodibility characteristics of each mapping unit in the Pinon Canyon Parcel were evaluated to determine the baseline soil erosion conditions. These conditions have already been discussed in Section 3.1.2, with detailed information in Appendix C. The following discussion is limited to applications specific to the Pinon Canyon Parcel.

Water Erosion

The amount of soil moved by water erosion has been predicted using the Universal Soil Loss Equation (USLE) and is shown on Table 3-15.

Approximately 36 percent of the parcel has low predicted soil losses under present conditions, approximately 18 percent is predicted to have moderate soil losses, 32 percent is predicted to have high soil erosion losses, and approximately 15 percent has very high erosion losses. Water erosion susceptibility by landscape type is shown in Figure 3-19. The effect of soil erosion movement on surface water quality is discussed in Section 4.1.4.

Wind Erosion

Wind erosion susceptibility by mapping unit is shown below in Table 3-16 and as illustrated for the general landscape types in Figure 3-20.

The broad plain and valley of the parcel (including LP, AP, SaP, SO and SE mapping units) are the most susceptible to wind erosion. Trees and shrubs are rare and the soils commonly have less than 5 percent rock fragment scattered on the surface of these units. Scattered dense sod clumps and the surface crust on the soil surface between clumps partially protect the soil surfaces under natural conditions, however when disturbed or exposed, these soils are highly susceptible to wind erosion losses (Section 3.2.6).

TABLE 3-14

SOILS AND VEGETATION SUMMARY FOR THE PINON CANYON PARCEL

(Preferred Boundary)

SOIL ANGE UNIT & ANCE SITE	ACRES (Hectares)	PERCENT OF PARCEL	SOILS AND PHYSIOGRAPHY	PERCENT PERENNIAL PLANT COVER Potential	'79 Transects	MAJOR NATIVE PLANTS OF POTENTIAL PLANT COMMUNITY	TOTAL ANNUAL PLANT YIELD- Pounds/Acre (Kilos/Hectare) Potential	'79 Estimate	PRESENT CONDITION AND STABILITY
P oamy lains	87,464 (35,397)	34.0	Deep and moderately deep medium-textured silty soils that are commonly calcareous to the surface, on broad gently sloping plains and mesas.	20	7.2 to 13.0	Blue grama dominates. Grows in association with galleta, ring muhly, red three-awn, squirrel-tail, cholla, prickly-pear, snakeweed, winterfat and other drought-enduring plants.	200-1500 (220-1680)	1250 (1400)	Fair Medium
amy ains ndstone eaks mplex	38,521 (15,589)	15.0	Moderately deep and shallow medium-textured stony soils that are noncalcareous with scattered areas of sandstone rock outcrops, on ridge tops and transitional areas between mesas and canyons.	30	10.8 to 14.6	Blue grama, black grama, side-oats grama, needle-and-thread, little blue-stem, mountain-mahogany, skunkbush, scattered juniper and pinyon. (See LP above for Loamy Plains.)	400-2400 (450-2690)	1400 (1570)	Fair Medium
line erflow	17,101 (6,921)	6.6	Deep medium-textured alluvial soils that are commonly calcareous and moderately alkaline, in swales and depressions along drainage-ways. These areas receive water from adjacent areas in addition to rainfall.	50	3.1 to 15.8	Western wheatgrass dominates. It is associated with alkali sacaton, galleta, vine mesquite grass, and 4-wing saltbush.	700-2500 (780-2800)	1300 (1460)	Poor Medium
P ndy ains	4,070 (1,647)	1.6	Deep coarse-textured soils forming on long wind deposited dunes crossing near the center of the parcel.	40	6.9 to 8.0	Blue grama forms the bulk of the cover; needle-and-thread, side-oats grama, sand dropseed, red three-awn, sand sagebrush, and yucca are important associated plants.	500-1600 (560-1790)	1400 (1570)	Fair Medium
my ins & estone aks plex	17,535 (7,096)	6.8	Shallow and moderately deep medium-textured soils weathered from limestone that are calcareous to the surface. Scattered limestone fragments on shallow soils occupy 60%, moderately deep soils with silty surface occupy 40%. On small ridges and transitional areas.	25	5.6	Bigelow sage, cholla, 4-wing saltbush, snakeweed, winterfat, yucca, side-oats grama, New Mexico feathergrass, blue grama, galleta and little bluestem. (See LP for Loamy Plains.)	200-1200 (220-1344)	1300 (1460)	Fair Low

TABLE 3-14 (Concluded)

SOIL RANGE UNIT & RANGE SITE	ACRES (Hectares)[1]	PERCENT OF PARCEL	SOILS AND PHYSIOGRAPHY	PERCENT PERENNIAL PLANT COVER Potential	'79 Transects	MAJOR NATIVE PLANTS OF POTENTIAL PLANT COMMUNITY	TOTAL ANNUAL PLANT YIELD- Pounds/Acre (Kilos/Hectare) Potential	'79 Estimate	PRESENT CONDITION AND STABILITY
PR Limestone Breaks - Pinyon-Juniper Complex	19,550 (7,921)	7.6	Shallow and medium-textured soils forming on limestone that are calcareous to the surface. Scattered limestone fragments on shallow soils occupy 50%, stony and rocky shallow soils occupy 30%, and rock outcrops of limestone and shale occupy 20%.	20		See MPD for Limestone Breaks portion. One seed Juniper and Pinyon form a canopy of 10% or more with many species associated with Sandstone and Limestone Breaks.			Fair Low
AP lkaline Plains	29,013 (11,742)	11.3	Moderately deep and deep fine-textured soils weathered from shale that are calcareous and moderately alkaline, on toe-slopes below limestone ridges and along drainages.	25	8.9 to 9.7	Alkali sacaton, blue grama, galleta, western wheatgrass, 4-wing saltbush, cholla, Fremont goldenweed and Frankenia.	500-2000 (560-2240)	900 (1010)	Poor Low
E aline verflow, roded	6,465 (2,616)	2.5	Shallow fine-textured soils forming on calcareous and alkaline shale that is exposed by erosion at heads of drainage.	25		Alkali sacaton, blue grama, galleta, winterfat, 4-wing saltbush, cholla, snakeweed and Fremont goldenweed form a sparse cover.	300-900 (340-1010)		Poor Very Low
rG inyon- niper & ckland	37,346 (15,114)	14.5	Stony moderately deep and shallow soils formed in sandstone colluvium that are noncalcareous, on canyon walls and sideslopes, occupying 60% of the unit. Cliffs and boulder rock outcroppings occupy 40%.			(See PR above for Pinyon-Juniper)			Fair Medium

lt Meadow - This unit (about 0.1 percent of the parcel) is in the wildlife protection area. It is not included in training unit plans.

referred boundary only.

urce: Field studies of soils and vegetation, November 1979, and aerial photographs.

TABLE 3-15

PREDICTED BASELINE WATER EROSION LOSSES,
SOILS OF THE PINON CANYON PARCEL

Mapping Unit Symbol	Range Site Components	Water Erosion Losses[a]	Percentage of Parcel
LP	Loamy Plains	Low	34.0
LS	Loamy Plains - Sandstone Breaks	High	15.0
PR	Limestone Breaks - Pinyon-Juniper	High	7.6
MPD	Loamy Plains - Limestone Breaks	High	6.8
SO	Saline Overflow	Moderate	6.6
TrG	Pinyon-Juniper-Rockland	Very High	14.5
AP	Alkaline Plains	Moderate	11.3
SE	Saline Overflow, eroded	High	2.5
SaP	Sandy Plains	Low	1.6
SM	Salt Meadow	High	0.1

[a]Based on soil erosion classes
Low = 0-2 T/ac/yr,
Moderate = 2-4.9 T/ac/yr,
High = 5-10 T/ac/yr, and
Very High = 10+ T/ac/yr.
(T/ac/yr = Tons/acre/year)

TABLE 3-16

WIND EROSION SUSCEPTIBILITY
OF EXPOSED SOILS, PINON CANYON PARCEL

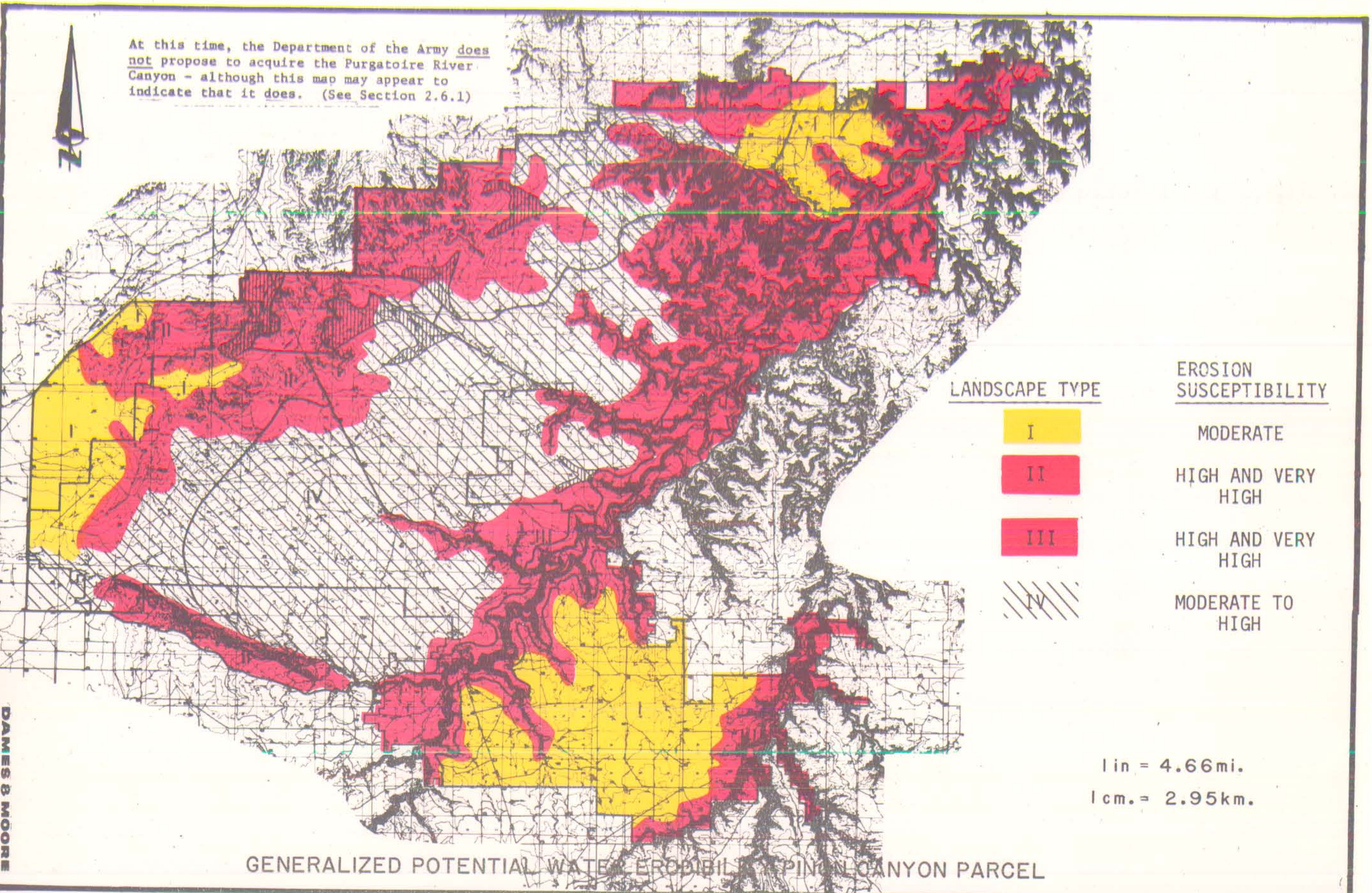
Mapping Unit Symbol	Range Site Components	Water Erosion Losses	Percentage of Parcel
LP	Loamy Plains	High[a]	34.0
LS	Loamy Plains - Sandstone Breaks	Moderate-Low	15.0
PR	Limestone Breaks - Pinyon-Juniper	Low	7.6
MPD	Loamy Plains - Limestone Breaks	Moderate-Low	6.8
SO	Saline Overflow	High	6.6
TrG	Pinyon-Juniper-Rockland	Low	14.5
AP	Alkaline Plains	High	11.3
SE	Saline Overflow, eroded	High	2.5
SaP	Sandy Plains	High	1.6
SM	Salt Meadow	Low	0.2

[a]Based on tree cover, rock & litter cover and aggregate stability of soils, see Appendix C.

3.2.3 Vegetation

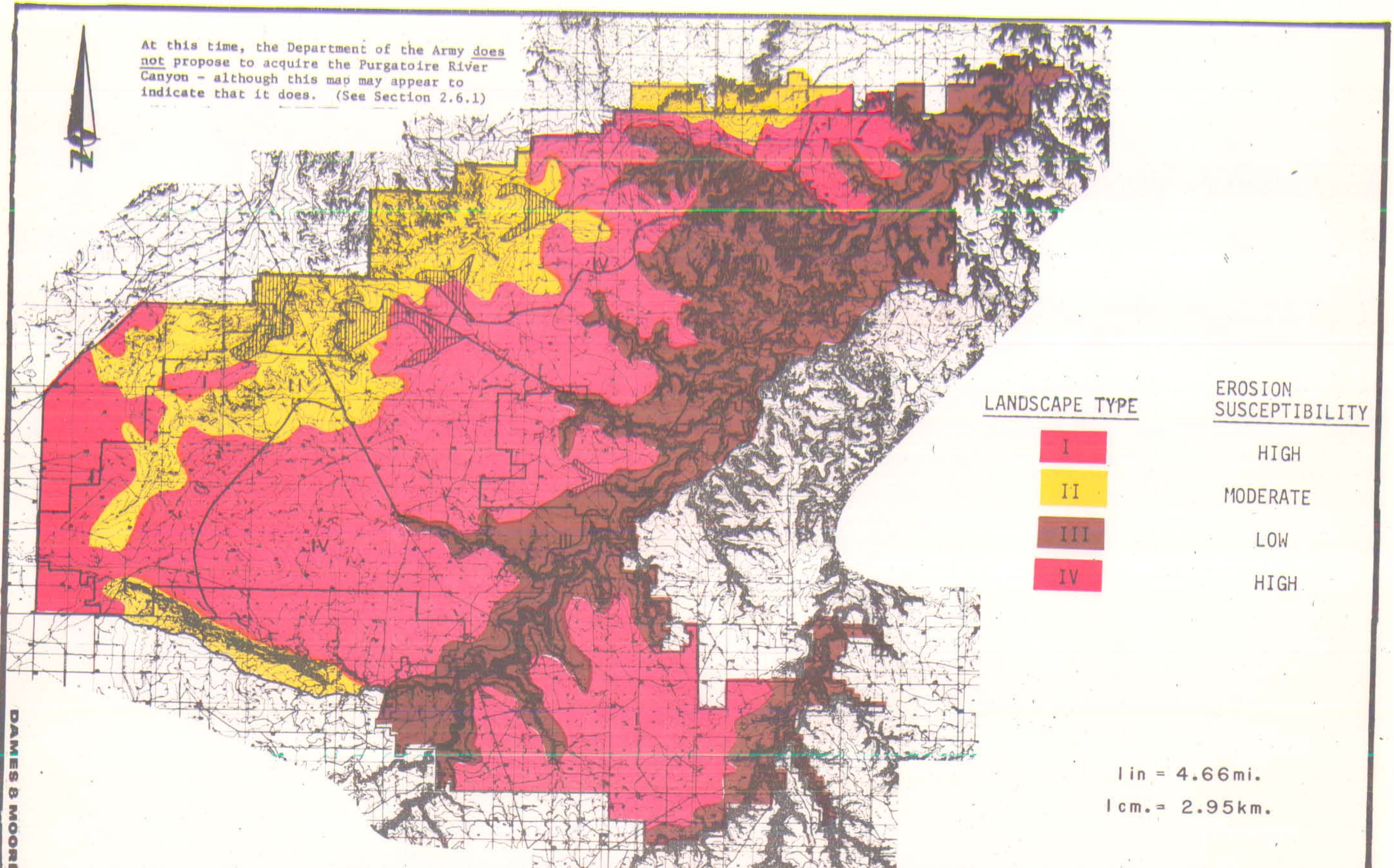
Geographical Setting and Vegetation

The Pinon Canyon Parcel is within the Upper Arkansas Valley Rolling Plains Major Land Resource Area (U.S. Department of Agriculture, Soil



GENERALIZED POTENTIAL WATER ERODIBILITY PIÑON CANYON PARCEL

DAMES & MOORE



GENERALIZED POTENTIAL WIND ERODIBILITY PINON CANYON PARCEL

DAMES & MOORE

FIGURE 3.

Conservation Service 1972, Rev. 1979, see Figure D-1). The vegetation is shortgrass plains and pinyon-juniper woodland with minor areas of riparian communities (Kuchler, 1975). See Section 2.4 for information on range site stability and Section 3.1.3 for information on abundance of plant species. Vegetation transect studies for this parcel are summarized on Table 3-17.

Range Site Stability

Range sites were classed into stability groups based on their ability to sustain disturbances and their response to opportunities to recover. This has been discussed in Section 2.4, and mapped on Figure 3-21.

Range Site Descriptions

Range sites as described by the SCS that occur on the Pinon Canyon Parcel are described in Appendix D. Soils and vegetation for the sites are summarized on Table 3-14.

Range Condition

The concept of range condition has already been discussed in Section 3.1.3. The Pinon Canyon Parcel also includes the Sandy Plains Range Site, in generally Fair condition. It does not include the Salt Meadow Range Site except in the wildlife protection area not included in training unit plans. Range condition at each transect location is shown in Table 3-17, and discussed below.

The Loamy Plains range site has the largest acreage of the sites of the Pinon Canyon Parcel. The 34.0 percent of Loamy Plains on the parcel represents a major kind of vegetation and soil. Above average precipitation in 1979 favored growth of Sunflowers, Russian Thistle and Kochia. If annuals are added to the production of the thin stand of perennials, which are dominated by blue grama, they will total an estimated 1250 pounds per acre air dry.[1] Production of climax species is well below potential for the site and the present range condition is Fair. Scattered over the site are localized areas of Poor range condition, where livestock have concentrated around watering places or where cultivated farm land was abandoned because of drought.

The Pinon Canyon parcel is characterized by many rocky canyons and breaks. The Sandstone Breaks range site is closely associated with canyon topography and forms 15.0 percent of the parcel. The present range condition of this site is generally Fair. Areas of the site that are remote and far from stock water are in higher condition. Junipers, pinyons, several shrubs and forbs grow with grasses to present a woodland aspect. Stoniness acts to favor plant growth by creating good soil moisture relations. The site's production in 1979 was an estimated 1400 pounds per acre.

[1]Subsequent production estimates are for an air dry basis.

TABLE 3-17

SUMMARY OF FIELD TRANSECTS ON THE PINON CANYON PARCEL

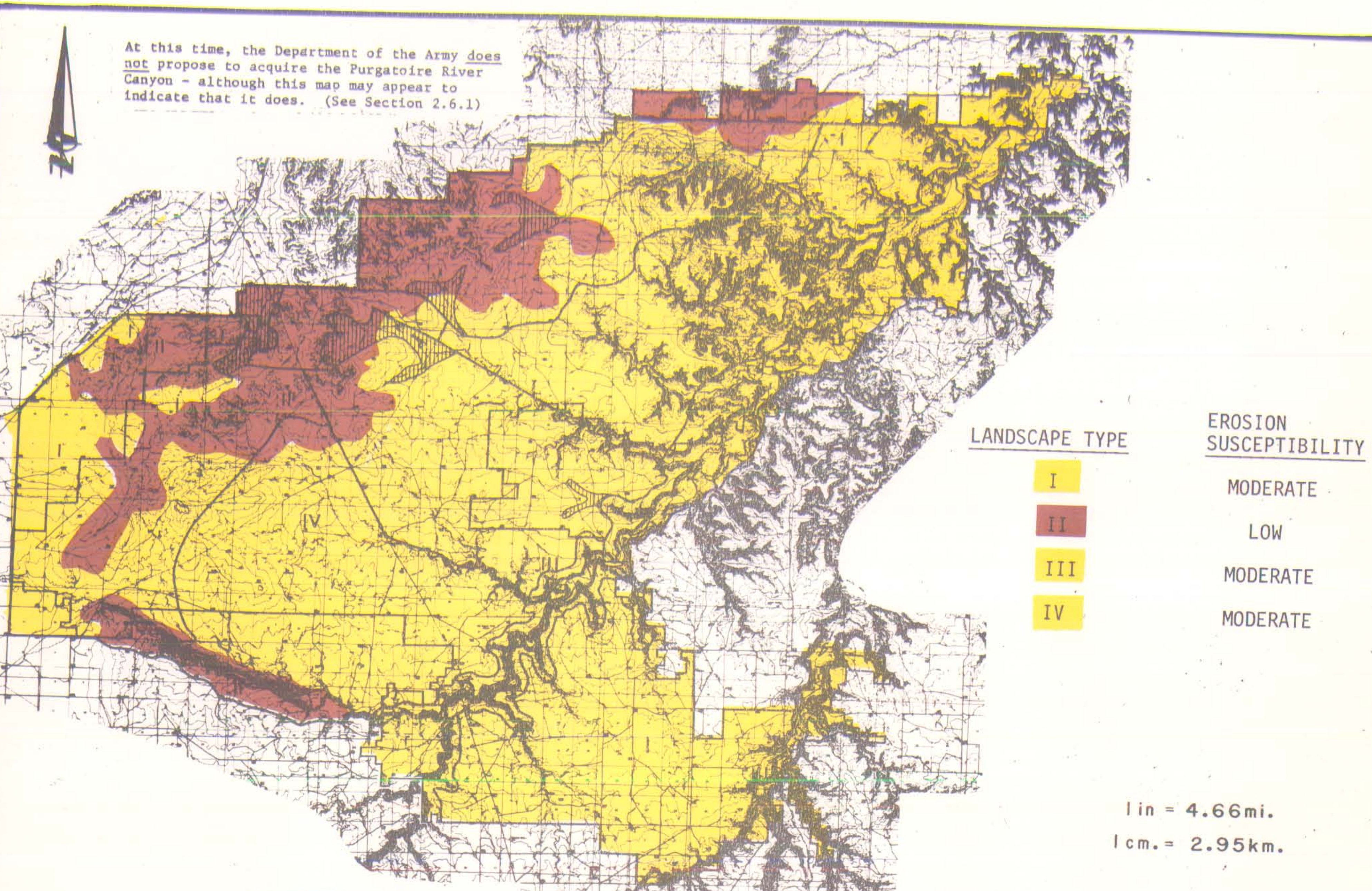
Range Site	Transect Number[a]	Percentages				Present Range Condition[d]
		Plant Cover[c]		Litter Cover	Rock Cover	
		Optimum[b]	Present			
Loamy Plains	1	20	13.0	5.4	0.9	Fair
Loamy Plains	3	20	7.2	8.2	0.1	Fair
Loamy Plains	13	20	11.4	3.1	0.2	Fair
Sandstone Breaks	2	30	9.7	4.3	63.8	Fair
Sandstone Breaks	4	30	17.2	6.2	7.2	Fair
Saline Overflow	5	50	15.8	10.2	0.3	Fair
Saline Overflow	11	50	3.1	9.0	0.0	Poor
Limestone Breaks	6	25	5.6	5.2	17.6	Fair
Sandy Plains	8	40	6.9	13.5	0.0	Fair
Sandy Plains	9	40	8.0	14.8	0.0	Fair
Alkaline Plains	10	25	8.9	16.2	0.3	Fair
Alkaline Plains	12	25	9.7	6.7	1.0	Fair

[a]Data for transects are in Appendix D. Locations of transects are shown on maps of management units, Appendix A. Data for Transect 7 were not representative.

[b]From SCS Range Site Descriptions.

[c]Cover is ground obscured by native perennial plants, litter and rock when viewed from directly overhead.

[d]Based on SCS Range Condition Guides--primarily kinds and amounts of plant species.



PREDOMINANT SITE STABILITY OF THE PIÑON CANYON PARCEL

DAMES & MOORE

The Limestone Breaks range site comprises 6.8 percent of the land area. Here a combination of scattered junipers and pinyons along with shrubs results in a diverse vegetation but dominated by grasses and forbs at the ground level. Estimated production in 1979 was 1300 pounds per acre with much of this from blue grama. Blue grama totalled over one third of the plant cover on Limestone Breaks. Range condition at the time of studies on the parcel was judged to be Fair. Areas not used heavily by livestock because of distance to water or because of natural barriers to livestock access are in higher condition. Other areas subjected to concentrations of livestock are in Poor condition.

The status of the Alkaline Plains range site, 11.3 percent of the parcel is typically Fair range condition; galleta, the most abundant grass, often comprised nearly 40 percent of the cover. Scattered over the parcel are localized areas of Alkaline Plains that are more depleted and in Poor condition. Alkaline Plains has the potential to produce as much as 1500 pounds per acre of climax species on the average. In its present condition an estimated 1000 pounds per year are produced.

The Saline Overflow range site totals 6.6 percent of the Pinon Canyon Parcel. Much of the site has deteriorated from its original form and condition and has experienced severe erosion. This site is almost all in Poor condition with production far below the potential. Estimated production for the site in 1979 was 1300 pounds per acre but a high percentage of this production was from plants not occurring in the climax plant community. This site, favored by a topographic position where it benefited from run in water and overflow drainages is at a serious disadvantage when not protected by adequate plant cover. It is highly vulnerable to erosion and until erosion can be checked, it is difficult to gain improvement in the vegetation.

The Sandy Plains range site, although limited in its distribution over the parcel, makes up 1.6 percent of the total rangeland. This site can produce an average of 1000 pounds per acre per year of climax plant species. Production in 1979, which included plants other than those in the potential, was estimated to total 1400 pounds per acre. The site was judged to be in Fair condition with blue grama comprising one half to almost three fourths of the total cover.

Minor range sites include Saline Overflow, Eroded (Shaly Plains), 2.5 percent, and Pinyon-Juniper and Rockland, 14.5 percent.

Endangered Plant Species

The list of endangered plant species in the Federal Register, June 16, 1976 contains the plant *Haplopappus fremontii* sp. *monocephalus* (A. Nels.) Hall. [*Oonopsis foliosa* (Gray.) Greene]. The plant is also listed in "An Illustrated Guide to the Proposed Threatened and Endangered Plant Species of Colorado" (U.S. Fish and Wildlife Services, 1978). The plant was found on the Pinon Canyon Parcel during vegetative studies for this Environmental Impact Statement. The plant grows in limited abundance on areas of Saline Overflow, Saline Overflow eroded and Alkaline Plains Range Sites of the parcel. Appendix D contains additional information on the plant.

3.2.4 Hydrology

Surface Water - General Description

The major watercourse, Purgatoire River, and several other streams located in the Pinon Canyon Parcel are identified on Figure 3-22. Local topography and major watershed divides are also indicated. High plains characterize the topography of the southern and western portions of the parcel, whereas rolling hills are features of the northern and central portions. The deeply incised rugged canyon of the Purgatoire River borders the eastern part of the parcel.

The Purgatoire River flows in a northeasterly direction along the border of the preferred boundary (Figure 3-22) to its confluence with the Arkansas River near Las Animas, Colorado. The headwaters of the Purgatoire River rise on National Forest land in the Culebra Range of the Sangre de Cristo Mountains in eastern Costilla County in Colorado and on the Maxwell Land Grant in northern New Mexico. The river drains generally in a southwest to northeast direction through mountains and across plains to its confluence with the Arkansas River. Trinidad Lake, located about four miles above Trinidad, Colorado and on the Purgatoire River, is a reservoir that is used for flood control, irrigation and recreation, and to help control sedimentation (U.S. Army Engineer District, 1974). Flow just below Trinidad Lake has been completely regulated since August 19, 1977 (U.S. Geological Survey, 1978).

The Purgatoire River in the Pinon Canyon Parcel sustains year-round flows for most years. However, the streams located in the parcel that are tributary to it are ephemeral. The larger ephemeral water-courses include Van Bremer Arroyo, Taylor Arroyo, Lockwood Canyon, Red Rock Canyon, Welsh Canyon, and Bent Canyon. Other ephemeral streams located in the parcel are tributary streams in the Timpas Creek drainage, which is located north of the parcel.

Streamflow

Continuous-record streamflow data from four USGS gaging stations on streams in and near the Pinon Canyon Parcel are available. These gaging station locations are shown on Figure 3-22. Pertinent streamflow data and other information for these stations are presented in Table 3-18. The average annual runoff and annual peak stages and discharges reported for the long-term gaging station on the Purgatoire River at Ninemile Dam, near Higbee, Colorado, about 8 miles (13 km) northeast of the parcel, are presented in Table E-7, Appendix E. These data indicate the yearly variability of runoff and the history of annual peak discharges.

TABLE 3-18

SUMMARY OF FLOW CHARACTERISTICS AT SELECTED STREAM-GAGING STATIONS IN AND NEAR THE PINON CANYON PARCEL

Name of Stream-gaging Station (USGS No.)	Location[1] Section	Township	Range	Drainage Area (sq. mi.)	Period of Record	Average Discharge (cfs)	Maximum Discharge (cfs)	(date)	Minimum Discharge	Remarks
Luning Arroyo near Model, Colo. (07126100)	33	31S	59W	86	Jul '66- Sep '77	1.21 (11 yrs)	9,400	Aug. 9, 1968	No flow for many days each year.	Records good
Van Bremer Arroyo near Model, Colo. (07126200)	13	31S	59W	168	Jul '66- Sep '77	2.09 (11 yrs)	6,240	May 26, 1967	No flow June 7-13, 1968.	Records good except those above 40 cfs, which are fair.
Purgatoire River near Thatcher, Colo. (07126300)	10	31S	58W	1,935	Jul '66- Sep '77	37.9 (10 yrs, prior to completion of Trinidad Lake)	15,100	June 17, 1967	No flow at times most years.	Records good except those for winter period, which are fair. Diversions above station for irrigation of about 30,000 acres.
Purgatoire River at Ninemile Dam, near Higbee, Colo.	7	27S	54W	2,900	Oct '24- Sep '77	94.5 (52 yrs, (prior to completion of Trinidad Lake)	105,000 (est.)	June 18, 1965	No flow at times most years.	Records poor Diversions for irrigation of about 32,000 acres above station.

[1]Refer to location on Figure 3-5.

Conversion Factors:
1 sq. mi. = 259,093 hectares (approximately)
1 cfs = 0.0283 m^3/s

Reference: U.S. Geological Survey, 1978.

Annual maximum discharge data for two USGS crest-stage, partial-record stations in and near the Pinon Canyon Parcel are also available. Data for stations located on Red Rock Canyon Creek in the parcel and on a Timpas Creek tributary about three miles (5 km) northwest of the parcel (Figure 3-22) are presented in Table 3-19. Such streamflow data are generally collected over a period of years by the USGS and used in various hydrologic analyses.

Detailed accounts of historical flooding on the Purgatoire River are discussed in U.S. Geological Survey Water-Supply Paper 997. Period-of-record flood data presented as peak stages and discharges for selected gaging stations are included in Tables E-7 and 3-19. Estimated flood discharges for the Purgatoire River at the Ninemile Dam gaging station are shown on Figure 3-23.

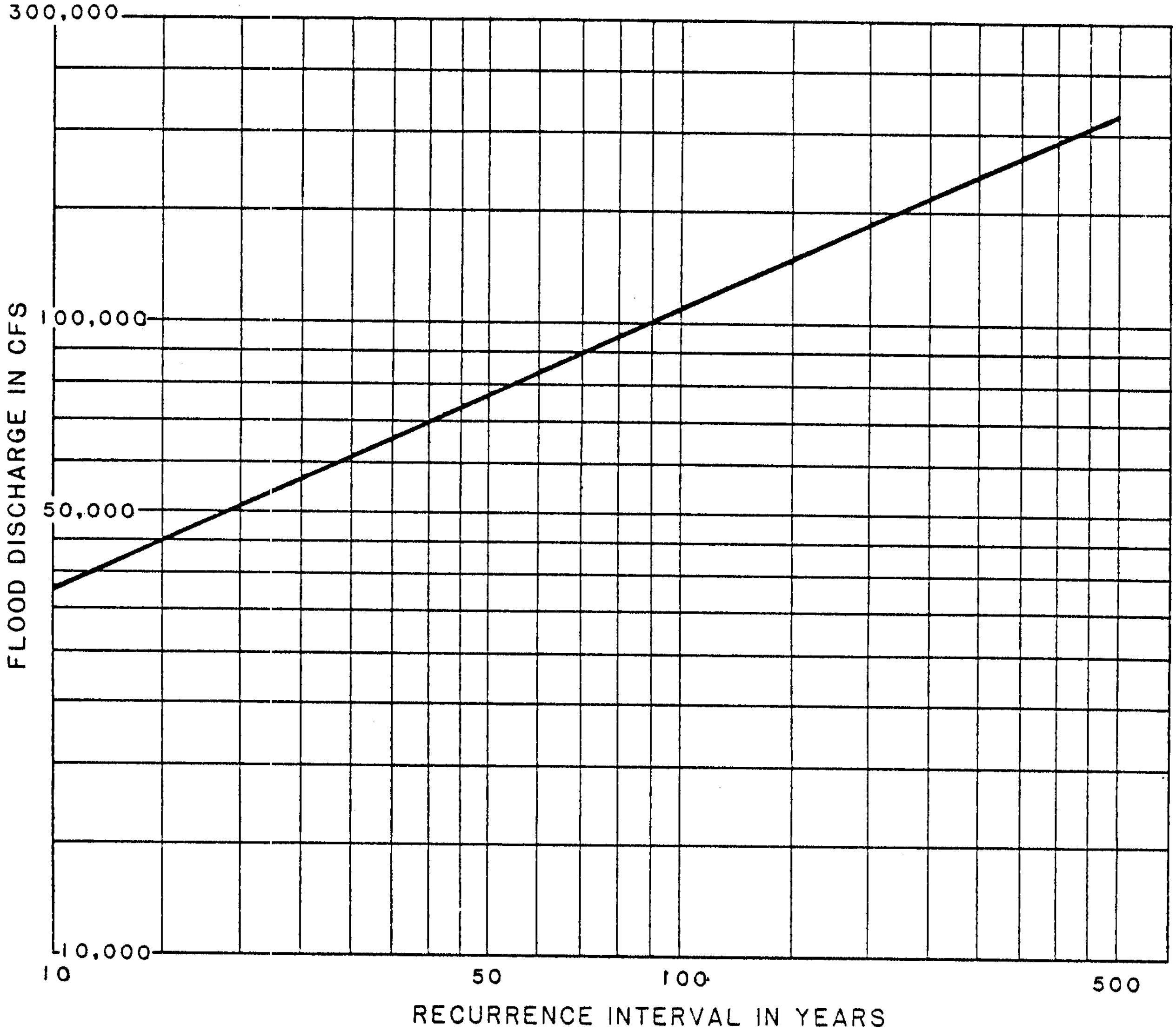
The first major flood on the Purgatoire River for which reliable records are available was recorded in September 1904. The travel time for the flood peak between Trinidad and the mouth of the river was about 20 hours. The velocity of discharge was estimated to be about 6-1/2 miles per hour (Follansbee and Sawyer, 1948) (10.5 kilometers/hour).

Earlier floods on the Purgatoire River occurred in 1859, 1866, 1875, 1878, 1883 and 1886. The 1875 flood, the first for which definite information was available, was described in the newspaper Las Animas Leader as follows (Follansbee and Sawyer, 1948):

> "...On September 16 a rush of water came down Purgatory (Purgatoire) River at Las Animas. The water was 5 feet higher than at any previous time that year. The Atchison, Topeka, and Santa Fe Railway Company's tracks were under water for one-half mile on each side of the Purgatory, the bridges being 3 to 4 feet under water. Up the Purgatory considerable damage was done, the greatest losses being of cord wood, stacked hay, cattle, fences, and adobe houses..."

The highest peak discharge actually recorded on the Purgatoire River was 105,000 cfs (about 2,970 m^3/sec) on 18 June 1965, at the gaging station at Ninemile Dam, near Higbee (U.S. Geological Survey, 1976). The second greatest flood of record occurred on 19 May 1955, and had a peak discharge of 80,000 cfs, or about 2,260 m^3/sec (U.S. Geological Survey, 1964). The third highest flood at the Ninemile Dam site was reported to be 64,500 cfs (about 1,830 m^3/sec) and occurred on 15 September 1934. During this flood, the Purgatoire River rose 10.7 feet (3.3 meters) in three hours, maintained the peak less than half an hour, then lowered nine feet (2.7 meters) in ten hours, and was back to normal stage the following day. The volume of flood run-off was about 23,000 acre-feet (Follansbee and Sawyer, 1948).

The flood season for the lower Purgatoire River Basin generally occurs during the late spring and summer months. Late spring snow



PINON CANYON PARCEL

ESTIMATED FLOOD DISCHARGES
FOR THE PURGATOIRE RIVER AT
NINEMILE DAM NEAR HIGBEE, COLORADO

REFERENCE: McCAIN AND JARRETT, 1976.

DAMES & MOORE

FIGURE 3-23

TABLE 3-19

ANNUAL MAXIMUM DISCHARGE AT CREST-STAGE PARTIAL-RECORD STATIONS

USGS Station Number	Station Name	Location	Drainage Area (sq mi)	Period of Record	Annual Maximum Data		
					Date	Height (feet)	Discharge (cfs)
07120600	Timpas Creek tributary near Thatcher, Colo.	Lat 37°34'18", long 104° 06'10", in NE¼ sec.34,T.28 S., R.60 W., Las Animas County, 150 ft (46 m) downstream from county road, 1.5 mi (2.4 km) north of Thatcher. Discontinued Sept. 30, 1977.	6.98[a]	1970-77	July 7, 1970	11.56	204
					July 23, 1971	11.64	220
					July 2, 1972	11.81	252
					Sept. 26, 1973	10.89	84
					May 31, 1974	10.67	57
					July 30, 1975	11.55[b]	202
					Oct. 4, 1975	10.96	94
					July 25, 1977	11.81	252
07126400	Red Rock Canyon Creek near Bloom, Colo.	Lat 37°33'24", long 103° 50'20", in SE¼SE¼ sec.36, T.28 S., R.58 W., Las Animas County, 1000 ft (300 m) upstream from county road crossing, 11 mi (18 km) southeast of Bloom. Discontinued Sept. 30, 1977.	3.62[c]	1970-77	July 22, 1970	10.86	26
					Aug. 7, 1971	17.30[b]	1,410
					July 6, 1972	16.48[b]	1,170
					July 19, 1973	12.79	250
					1974	[d]	4.0
					Aug. 14, 1975	10.20	8
					July 22, 1976	16.20[b]	1,100
					June 24, 1977	10.77	23

(a) 1.91 mi^2 are probably noncontributing.

(b) From floodmarks.

(c) 0.22 mi^2 are probably noncontributing.

(d) Peak stage did not reach bottom of gage.

Conversion Factors:
1 sq. mi. = 259,093 hectares (approximately)
1 foot = 0.305 m
1 cfs = 0.0283 m^3/s

References: U.S. Geological Survey; 1971, 1972, 1973, 1974, 1975, 1976, 1977 and 1978.

storms at the higher elevations and high-intensity rains over the plains region can produce rapid runoff characterized by high peak flows, small volumes, and short durations, particularly during July. The duration of floods on the tributaries would generally be shorter than those on the Purgatoire River. Also, the associated peak discharges and runoff volumes would generally be smaller from a storm event of a given frequency. The basin area of the Purgatoire River in the Pinon Canyon Parcel is subject to heavy rains that locally are true cloudbursts, particularly in the canyon sections. Floods from these areas can be locally severe (Follansbee and Sawyer, 1948). Near the southern boundary of the parcel, peak flows of the Purgatoire River reportedly are regulated to some extent by Trinidad Dam (U.S. Geological Survey, 1978).

Surface Water Use

Decreed surface water rights on the Pinon Canyon Parcel from Van Bremer Arroyo and its tributaries above the gaging station on this stream, are listed on Table 3-20. Historically, any direct storm runoff was normally intercepted in irrigation ditches and distributed to irrigate pasture land. There is also a reported surface water user by the name of Arnet, using 12 cfs on Taylor Arroyo in the parcel at Sec. 2, T30S, R59W (U.S. Army, Environmental Feasibility Review, Pinon Canyon site, no date) (see Appendix E, reproduction from the report Water, Pinon Expansion Site, Fort Carson, by J.W. Patterson & Associates, Inc. 1980). Additionally, Luning Arroyo in the vicinity of the Piñon Canyon Parcel is highly adjudicated.

Quality of Surface Water

Purgatoire River

Within the Pinon Canyon Parcel, the reach of the Purgatoire River from the south boundary of the parcel to its confluence with Taylor Arroyo is a designated moderate fishery resource, and the reach from this point of confluence to the north boundary of the parcel is a designated limited fishery resource. The Purgatoire River downstream of the parcel to its mouth is also a designated limited fishery resource, as discussed in Section 2.3.5. Chacuaco Creek within the offered boundary and downstream to its mouth is also a designated limited fishery resource. (Colorado Division of Wildlife, 1979.)

The Colorado Department of Health collected water samples from the Purgatoire River south of Las Animas at Highway 101 during the water quality survey from November 1971 through June 1972. Physical, chemical and bacteriological analyses of the collected samples are in Table 3-21. Measurements of TDS ranged from 3,130 ppm (3,130 mg/1) to 4,300 ppm (4,300 mg/1). It is noteworthy that the Purgatoire River was reported to drain alkali watersheds and contribute significantly to the high dissolved salt concentrations in the Arkansas River (Misbach, 1973).

TABLE 3-20

DECREED SURFACE WATER RIGHTS ON THE PINON CANYON PARCEL
(FROM VAN BREMER ARROYO AND ITS TRIBUTARIES)

Location			Name	Appropriation Date	Adjudication Date	Decreed Amount
Township	Range	Section				
30S*	60W	27	Brown #3 Ditch	11-11-1909	1-12-1925	3.9 cfs
30S*	60W	28	Brown #3 Ditch	11-14-1909	1-12-1925	3.9 cfs
30S*	60W	28	Brown #3 Ditch	9-01-1914	1-12-1925	3.9 cfs
30S	60W	29	Brown #4 Ditch	11-19-1914	1-12-1925	6.5 cfs
30S	60W	14	Brown #3 Reservoir	12-26-1914	1-12-1925	26.5 ac-ft
30S	60W	14	Mike Gagliardi Reservoir	5-01-1919	1-12-1925	186.0 ac-ft

*Indicates that Brown claims 3.9 cfs from two sources at three diversions, the total of all three diversions can only total 3.9 cfs.

Conversion Factors:
1 cfs = 0.0283 m^3/s
1 acre-foot = 1,230 m^3

Reference: J. W. Patterson & Associates, Inc., 1980; Army, U.S., date unknown.

TABLE 3-21

SUMMARY OF WATER QUALITY REPORTED FOR PURGATOIRE RIVER DURING ARKANSAS RIVER SURVEY

Parameter	Purgatoire River South of Las Animas at Highway 101			
	January or February, 1972	February 17, 1972	April 11, 1972	May 10, 1972
Dissolved oxygen (ppm)	12.4	12.0	10.3	10.0
Temperature (°F)	33	39	70	72
Flow (cfs)	18	30	4.5	3
pH (Standard Units)	7.7	7.0	--	7.9
Turbidity (jtu)	23	60	35	35
Chloride (ppm)	64.8	60.0	62.0	22.5
Phosphate (ppm)	0.04	0.03	0.04	0.50
Ammonia (ppm)	0.50	0	0.50	0.45
Nitrate (ppm)	0.60	0.53	0.40	0.70
Alkalinity (ppm)	250	205	240	182
Conductivity (micromhos)	2010	1930	1850	1935
Total Dissolved Solids (ppm)	4160	3930	4300	3130
Suspended Solids (ppm)	--	--	--	--
Settleable Solids ml/l)	--	--	--	--
BOD_5 (ppm)	8	12	12	10
Total Coliform (org./100 ml)	<200	<200	5800	2700
Fecal Coliform (org./100 ml)	<20	32	29	31
Dissolved Oxygen - % saturation	99	105	135	135

Reference: Misbach, 1973.

Environmental Protection Agency (EPA) data include the water quality for the Colorado Department of Health monitoring station near Hoehne, Colorado, about 12 miles (19 km) southwest of the Pinon Canyon Parcel. Table 3-22 summarizes selected water quality parameters of the Purgatoire River as determined from samples collected at this site. These and other water quality parameters are presented on Table E-8. The data indicate high levels of TDS at nearly 3,000 mg/l in the Purgatoire River below Trinidad. Also, concentrations of ammonia and phosphorus are reportedly high. Comparison of these water quality parameters to current drinking water standards indicate that the water quality of the lower Purgatoire River in the reach near Hoehne is poor and not suitable as a source of potable water. The data also indicate that TDS concentrations tend to increase in a downstream direction from near Hoehne to the river's mouth.

Pollution Sources within the Pinon Canyon Parcel

No point sources of pollution have been identified on the area of the Pinon Canyon Parcel. However, soil erosion (nonpoint source of pollution) on the rangelands, and, to a lesser extent, that from dry farmlands or abandoned communities, is expected to be a problem. Most of the Pinon Canyon Parcel has been overgrazed in recent years, producing an extremely loose, readily erodible soil condition. A high sedimentation potential to streams is evident, particularly during storm runoff from rangeland. No data are presently available, however, on areas in this parcel characterized by severely eroding stream banks and deep gullies as were available for the Huerfano River Parcel (Section 3.1.4).

For anticipated average annual runoff conditions, potential annual sediment yields in ton per square mile per year for major watershed areas within the preferred boundary of the Pinon Canyon Parcel were estimated. Results are presented in Table 3-23. The method of analysis is discussed in Appendix E.

Based on the sediment analyses for the above conditions, most lands in the northern portion of the Pinon Canyon Parcel are subject to potentially high sedimentation to waters (greater than 1,960 tons per square mile per year) under average annual runoff conditions. However, the watershed areas in the southern portion of the parcel are estimated to produce moderate sediment yields (range 920 to 1,370 tons per square mile per year). The estimated total average annual sediment loading from lands within the parcel is 1,540 tons per square mile. This is slightly lower than the annual sediment yield of 1,549 tons per square mile reported for the Purgatoire River at Trinidad for the years 1940 through 1953 (U.S. Department of Agriculture, 1980).

Estimated annual sediment yields (Table 3-23) are variable throughout the Pinon Canyon Parcel, but a general comparison can be made. The potential for estimated average annual sediment loading to the Purgatoire River from the watershed areas in the southern portion of the parcel is

TABLE 3-22[a]

SELECTED EPA WATER QUALITY PARAMETERS
FOR PURGATOIRE RIVER NEAR HOEHNE, COLORADO

Parameter	Concentration		
	Minimum	Maximum	Mean
BOD (mg/1)	.4	3.4	1.5
Cadmium (μg/1)	.0	4.0	.17
Dissolved Oxygen (mg/1)	4.8	64.0	9.58
Fecal Coliform (specimens/100 ml)	22.0	1,720,000	50,774.9
pH (SU)	7.6	8.8	8.17
Temperature (°F)	76.0	32.0	48.44

[a]See additional data on Table E-8, Appendix E.

TABLE 3-23

ESTIMATED TOTAL SEDIMENT YIELDS IN MAJOR WATERSHED AREAS WITHIN PREFERRED BOUNDARY OF PINON CANYON PARCEL

Designated Watershed Unit Name in Parcel	Drainage Area (square miles)	Estimated Total Sediment Yield (tons/square mile/year)
Sheep Canyon Arroyo	0.4	1,240
Local Area to Timpas Creek Drainage	31.5	1,360
Local Area to Simpson Lake (non-contributing area in Timpas Creek Drainage)	4.7	500
Local Area to Luning Arroyo	5.8	1,200
Van Bremer Arroyo	64.5	920
Taylor Arroyo	84.0	1,080
Lockwood Arroyo	60.1	1,370
Red Rock Canyon	55.2	2,220
Bent Canyon	70.5	2,260
Minnie Canyon	9.4	2,260
Local Area to Purgatoire River (western portion)	14.3	1,960
	Average for Parcel	1,540

NOTE: Local area refers to contributing intervening drainage area between major watershed divides.

Based on U.S. Department of Agriculture, 1980:
- Very High Sediment Yield - 5100 tons per square mile per year
- High Sediment Yield - 1700-5100 tons per square mile per year
- Moderate Sediment Yield - 850-1700 tons per square mile per year
- Low Sediment Yield - 340-850 tons per square mile per year
- Very Low Sediment Yield - less than 340 tons per square mile per year

Conversion Factors:
- 1 square mile = 259,093 hectares (approximately)
- 1 ton/square mile/year = 2.8×10^{-6} m^3/hectare/year (approximately)

less than that estimated from the northern portion. Within the parcel, poorer quality of surface waters may be anticipated in runoff from the contributing northern watershed areas than from the southern areas.

Ground Water Hydrology

The Dakota Sandstone and the Cheyenne Sandstone, which is the basal member of the Purgatoire Formation, are the principal aquifers producing usable ground water within the Pinon Canyon Parcel. Relative thickness and approximate depth to the two principal aquifers are shown in Figure 3-24, a generalized cross-section through the parcel. Table 3-24 lists the water-bearing characteristics of the major geologic units found on the parcel. A 1977 owner survey (Hancock Agency, 1977) indicated that the 31 inventoried wells located within the parcel boundary (Figure 3-22) have a total reported aggregate yield of approximately 750 gallons per minute (gpm) (47 liters/second (l/s). Two springs were also inventoried during the survey, each having a reported yield of 45 gpm (2.8 l/s). The majority of existing wells have reported yields of less than 15 gpm (0.9 l/s). One well is reported to produce 300 gpm (18.9 l/s). These data should be treated with caution as none of the wells' yields were measured during the survey.

Limited data are available on ground water quality for the two principal aquifers. The majority of existing wells are utilized for stock watering, however, specific analyses are lacking. Two water analyses were made available during the 1977 survey (Hancock Agency, 1977). Both analyses, one from a well and the other from a spring, were from Township 30 South, Range 58 West, and contained in excess of 2,500 milligrams per liter(mg/l) Total Dissolved Solids (TDS). Each water sample was high in sulfate (> 1500 mg/l) and very hard.

3.2.5 Wildlife Ecology

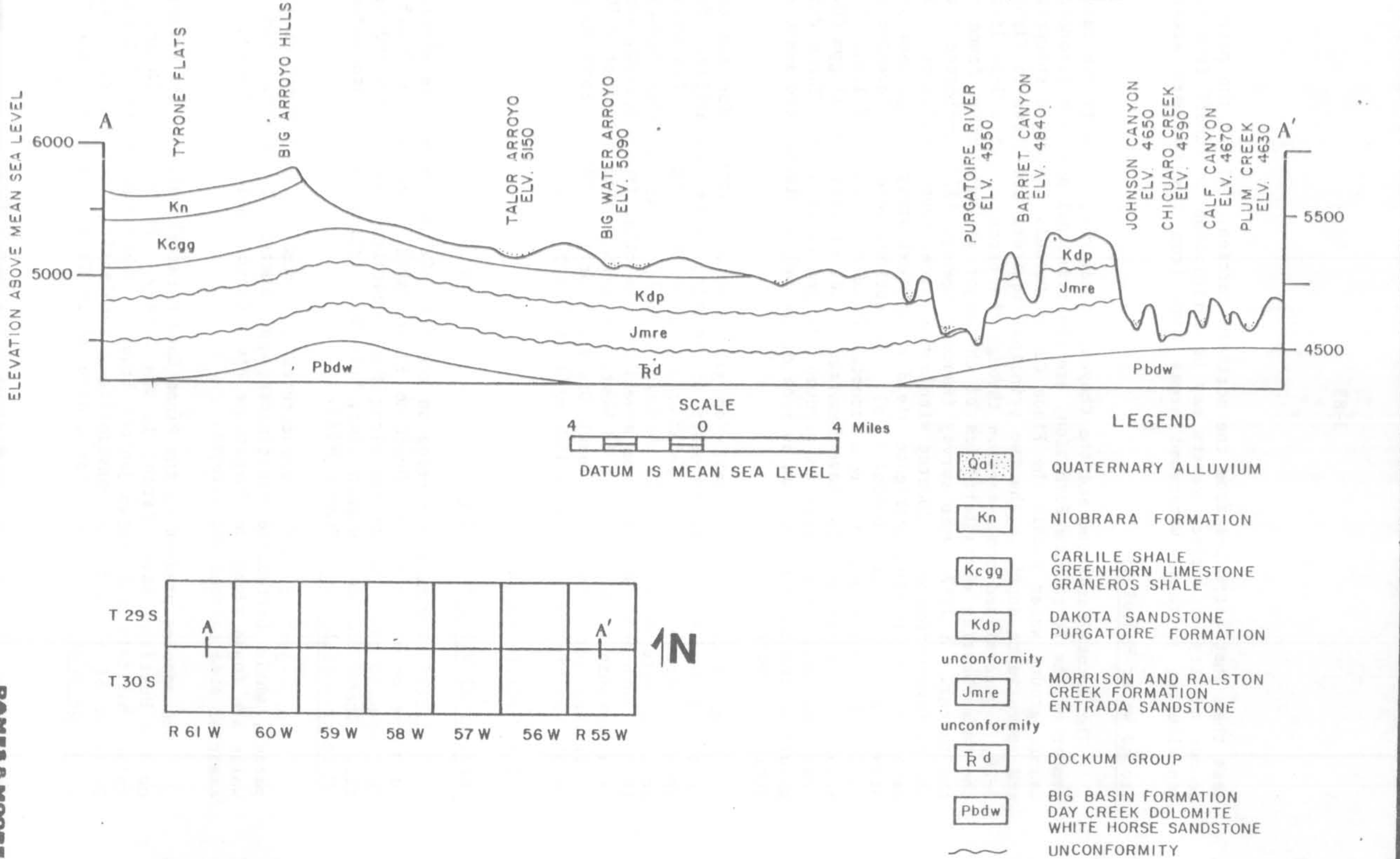
Terrestrial Wildlife Ecology

Wildlife habitats occurring on the Pinon Canyon Parcel are similar to those occurring on the Huerfano River Parcel (see Section 3.1.5). Most species are concentrated along the Purgatoire River canyon and its rim. These include Mountain Lion, Mule Deer (Figure 3-25), and Turkey (*Meleagris gallopavo*) (Figure 3-26).

Pinyon-juniper habitat constitutes approximately 27 percent of the parcel, while bottomland constitutes approximately 2 percent. Canyon walls are found along the Purgatoire River Canyon, Red Rocks Canyon, and assorted side canyons and arroyos.

One species present on the Pinon Canyon Parcel which is not present on the Huerfano River Parcel is the Turkey. It is found in brushy upland habitats and Pinyon-juniper breaks. Additionally, the Colorado Division of Wildlife is considering transplanting some Bighorn Sheep (*Ovis canadensis*) to the Purgatoire River Canyon (see Appendix F).

GEOLOGIC CROSS SECTION THROUGH PINON CANYON PARCEL



DAMES & MOORE

FIGURE 3-24

TABLE 3-24

GENERALIZED SECTION OF THE GEOLOGIC FORMATIONS IN THE PINON CANYON PARCEL

System	Series	Symbol	Subdivision	Member	Thickness (feet)	Physical Character	Water Supply
QUATERNARY	Recent	Qal	Alluvium		0-50	Sand and Gravel	Yields adequate quantities of water for domestic and stock use. Locally yields suffiecnt water for irrigation.
CRETACEOUS	Upper	Kn	Niobrara Formation	Smoky Hill Marl	400-500	Gray to buff calcareous to chalky and sandy shale with thin limestone beds	Locally yields small quantities of water to a few domestic and stock wells
				Fort Hays Limestone	50-70	Light-gray limestone with thin chalky shale partings	Yields water to many domestic and stock wells
		Kcgg	Carlile Shale	Codell Sandstone	5-30	Sandstone and shaly sandstone	Yields water to many domestic and stock wells
				Blue Hill Shale	220-260	Gray to black shale	Does not yield water to wells
			Greenhorn Limestone		25-35	Thin gray limestone interbedded with dark-gray calcareous shale	Yields small quantities of water to a few domestic and stock wells
			Graneros Shale		185-235	Platy chalky shale	Yields no water to wells in Pinon Canyon Parcel
	Lower	Kdp	Dakota Sandstone		115-125	Fine grained, thin bedded to massive sandstone containing clayey and sandy shale	Yields water for domestic and stock use
			Purgatoire Formation	Kiowa Shale	15-25	Shale and sandy shale	Yields little or no water to wells in Pinon Canyon Parcel
				Cheyenne Sandstone	95-135	Massive white to buff fine-grained sandstone	Yields water to many wells and springs in Pinon Canyon Parcel
JURASSIC		Jmre	Morrison Formation		260-300	Varicolored shale, siltstone and sandstone	Not known to yield water to wells in Pinon Canyon Parcel
			Entrada Sandstone		30-70	White to buff massive fine-to-medium grained sandstone	Not known to yield water to wells in Pinon Canyon Parcel
TRIASSIC	Upper	Trd	Dockum Group		250-400	Moderate-reddish-brown medium-grained sandstone, siltstone, and local gray limestone	Water supply & quality not known
PERMIAN		Pbdw	Big Basin Formation		150-300	Reddish-brown platy siltstone and fine grained sandstone	Water supply & quality not known
			Day Creek Dolomite			Cross laminated dolomite locally in two or more separated by calcareous siltstone	Water supply & quality not known
			White Horse Sandstone Equivalent			Fine-grained sandstone and shale	Water supply & quality not known

Adapted From: McLaughlin, T.C., 1966, Ground Water in Huerfano County, Colorado U.S. Geological Survey Water Supply Paper 1805.

Scott, G.R., 1968, Geologic and structure contour map of the La Junta Quadragle, Colorado and Kansas, USGS Miscellaneous Geologic Investigations Map I-560

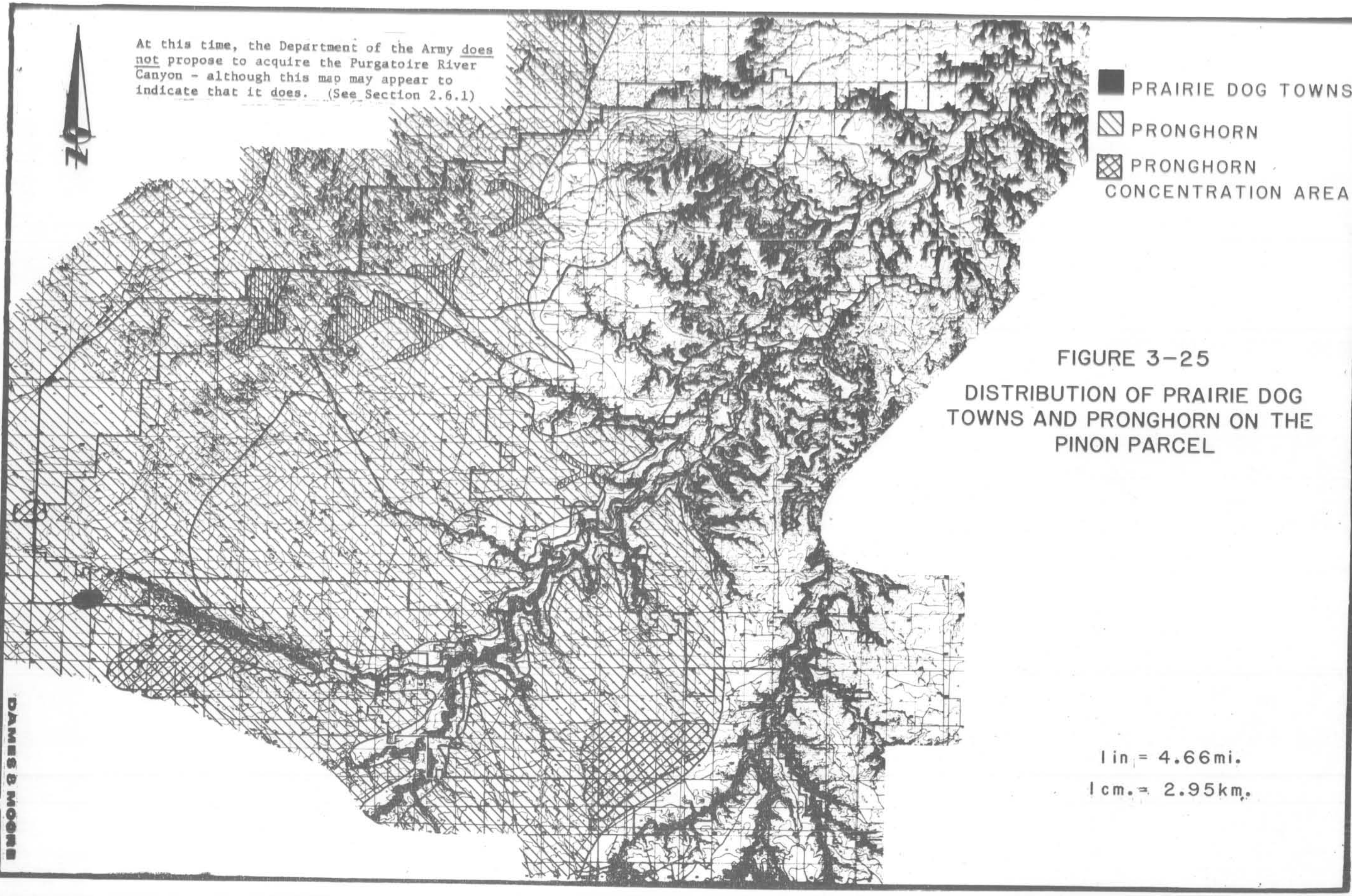


FIGURE 3-25

DISTRIBUTION OF PRAIRIE DOG TOWNS AND PRONGHORN ON THE PINON PARCEL

At this time, the Department of the Army does not propose to acquire the Purgatoire River Canyon - although this map may appear to indicate that it does. (See Section 2.6.1)

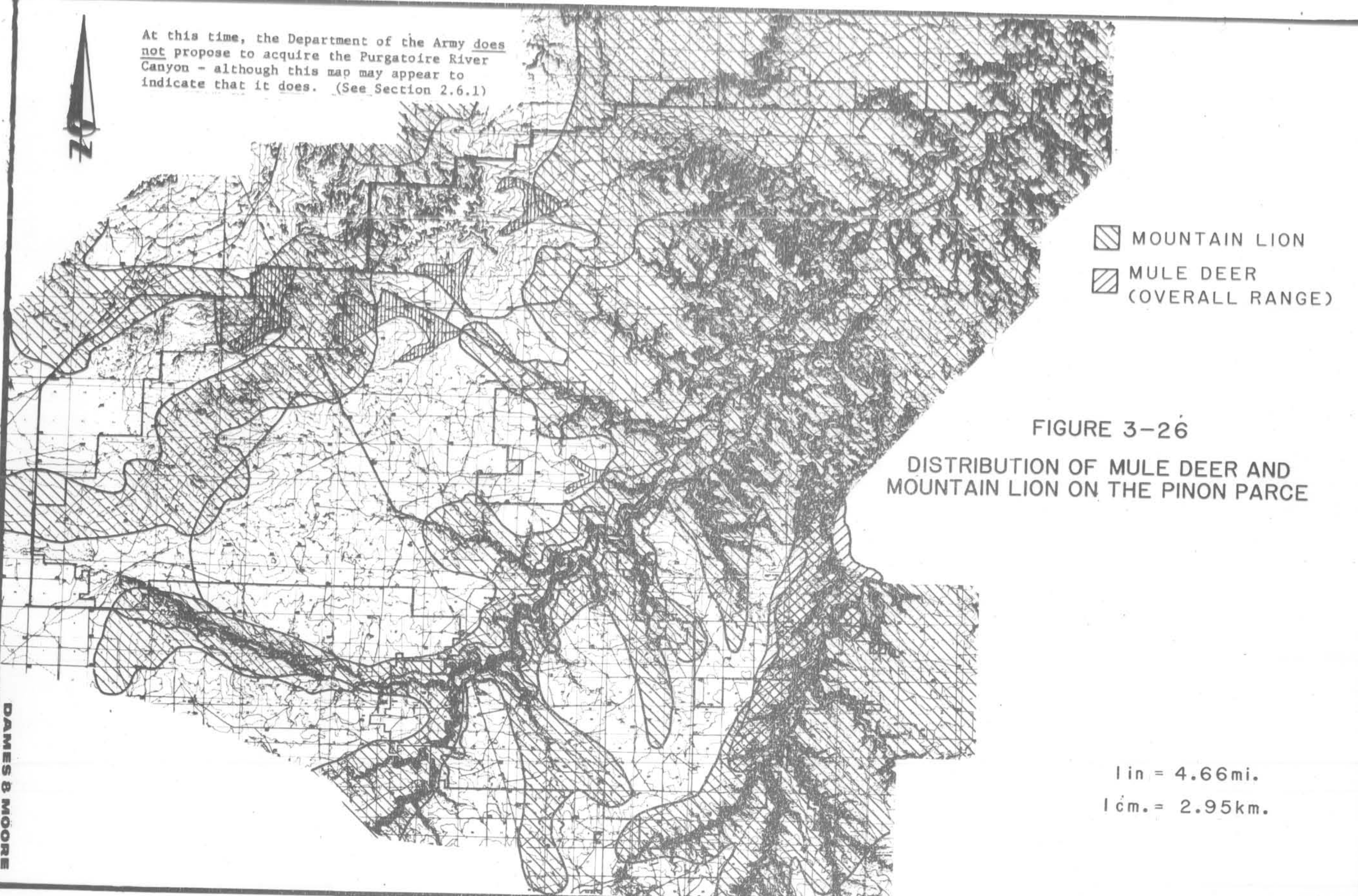


FIGURE 3-26

DISTRIBUTION OF MULE DEER AND MOUNTAIN LION ON THE PINON PARCE

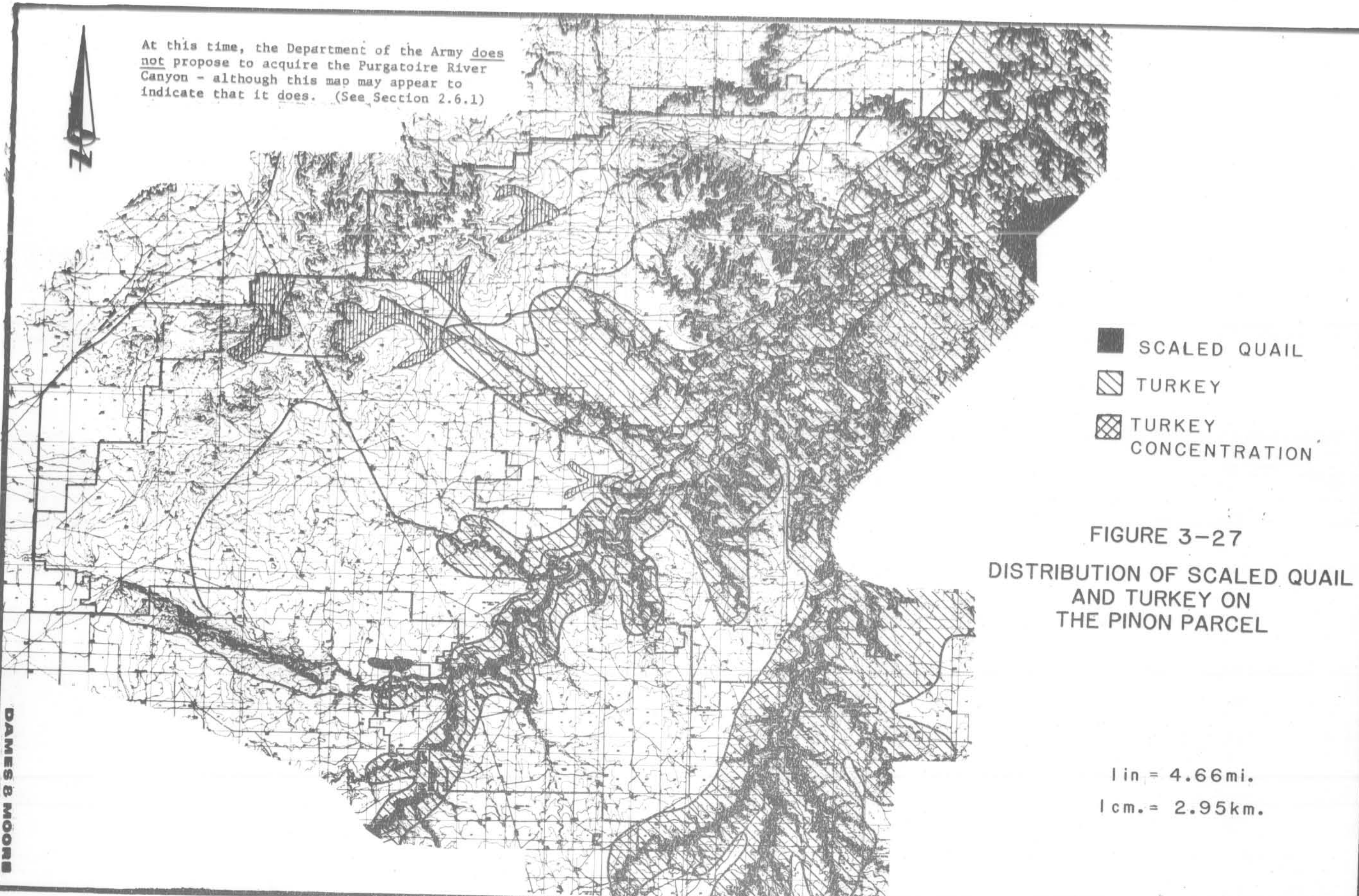


FIGURE 3-27

DISTRIBUTION OF SCALED QUAIL AND TURKEY ON THE PINON PARCEL

Endangered and Threatened Species

As on the Huerfano River Parcel (see Section 3.1.5), Bald Eagle, Peregrine Falcon and Black-footed Ferret potentially occur on the Pinon Canyon Parcel.

As on the Huerfano River Parcel (Section 3.1.5) Bald Eagles are not known to nest on the parcel, but they have been observed there during the winter (see Appendix F).

The Purgatoire River Canyon presents potential nesting habitat for Peregrine Falcons but none are known to nest there presently. However, the Colorado Division of Wildlife is considering planting a pair of peregrines in the Purgatoire River Canyon (see Appendix F).

An aerial survey to inventory raptor species in portions of the Pinon Canyon Parcel was conducted on April 7-9, 1980. Two helicopters, each flying two observers, were utilized to conduct the survey. Detailed results are presented in Appendix F. In summary, 295 individual raptors comprising 12 species were observed. Three Bald Eagles (two mature, one sub-adult) were counted. All three were observed soaring over side canyons to the Purgatoire River.

Three prairie dog towns (Figure 3-27) occur near the western edge of the Pinon Canyon Parcel presenting potential habitat for Black-footed Ferret (see Section 3.1.5). No Black-footed Ferrets are known to occur on the parcel presently. However, a confirmed sighting of a Black-footed Ferret was made east of Tyrone in 1971 and 1972 (Personal communication, Mr. Chuck Loeffler, Regional Nongame Biologist, Colorado Division of Wildlife, Colorado Springs, July 13, 1979.

Aquatic Ecology

Permanent aquatic habitat on the Pinon Canyon Parcel is limited to the Purgatoire River, Red Rocks Canyon, Taylor and Van Bremer Arroyos, and several springs and stock ponds. All other waterways on the parcel are intermittent in nature and offer temporary aquatic habitat.

The Purgatoire River is the major perennial watercourse on the parcel. As it flows northward toward the parcel the quality of the aquatic habitat diminishes (U.S. Army Engineer District, 1974). "Many of the biotic and abiotic parameters required by aquatic plants and animals rapidly deteriorate and are reflected in the poverty of aquatic biota. Limitations due to flash floods, turbidity, sandy substratum, low flows, scarcity of pools for cover, limited food production areas and vegetative shoreline, severely limit the presence and development of aquatic life." (U.S. Army Engineer District, 1974.) A fisheries survey performed by the Colorado Division of Wildlife on the Purgatoire near its confluence with the Arkansas River on September 21, 1979 recorded Carp (*Cyprinus carpio*), Chubs (*Hybopsis placitus*), Sand Shiners (*Notropis stramineus*), Fathead

Minnows (Pimephales promelas), Red Shiners (Notropis lutrensis) and Plains Stoneroller (Campostoma anomalum) (Miller, 1980).

The Purgatoire River has been designated as a moderate fishery resource, from the south boundary of the parcel to its confluence with Taylor Arroyo. The reach from this point to the north boundary of the Pinon Canyon Parcel is classified as a limited fishery resource (U.S. Environmental Protection Agency, et al., 1979) (see Figure 3-22). The problems of the past, which include overgrazing and coal mining; and present municipal and agricultural diversions and discharges have contributed to low aquatic productivity and diversity. At present, high levels of fecal coliforms, salinity (TDS), ammonia, phosphorous and oxygen demanding substances (BOD) are found in the Purgatoire River (Colorado Department of Local Affairs, 1979).

The historical ranges of the Arkansas River Darter (Etheostoma cragini) and the Arkansas River Speckled Chub (Hybopsis aestivalis tetranemus), offically listed by Colorado as threatened species, occur on the Pinon Canyon Parcel (Colorado Division of Wildlife, 1978). Limited sampling has not collected either fish on the parcel.

The occurrence of potential habitat for the Arkansas River Speckled Chub is possible since the fish is known to prefer open channels with a noticeable current, and the Purgatoire River sustains year round flows for most years. The Arkansas River Darter prefers small springs or seeps which are also present on the parcel.

Detailed data regarding the Pinon Canyon Parcel aquatic ecology is located in Appendix F.

3.2.6 Meteorology and Air Quality

Climatology

The climate of the Pinon Canyon Parcel is similar to that of the Huerfano River Parcel (Section 3.1.6).

Data Base

As discussed in Section 3.1.6, long term climatic data records are needed to establish representative averages for the area. Within the borders of the Pinon Canyon Parcel, only Doherty Ranch has sufficient precipitation records to be considered a good climatic average. However, the Doherty Ranch stations collect only precipitation data; therefore the Trinidad FAA Airport data was used for the temperature analysis. No summarized data are available from Trinidad for parameters such as freeze threshold, wind direction and speed, relative humidity, and the number of thunderstorm days. Data from Pueblo Airport, which is the closest station, were used for the analysis of these parameters. Throughout the climatological description of the Pinon Canyon Parcel, the most representative data that are available were used.

Temperature

Monthly means and extremes of temperature recorded at Trinidad Airport are presented in Table G-13 in Appendix G. The data show that extreme temperatures have ranged from a low of -32°F (-36°C) to a high of 106°F (41°C). January is typically the coldest month with an average daily minimum of 15.6°F (-9°C) and an average daily maximum of 46.1°F (8°C). July is the warmest month with an average daily maximum of 88.6°F (31°C) and an average daily minimum of 57.9°F (14°C). The mean monthly temperatures range from 30.9°F (-1°C) in January to 73.3°F (23°C) in July. The data in Table G-14 show that the daily maximum temperatures can be expected to equal or exceed 90°F (32°C) on an average of 39 days per year, and that the daily maximum will fail to rise above 32°F (0°C) on an average of 17 days a year. Daily minimum temperatures can be expected to be below 32°F (0°C) 159 days a year and below 0°F (-18°C) nine days per year. Mean dates of first and last occurrences of selected freeze threshold temperatures at Pueblo are presented in Table G-3.

Relative Humidity

Mean relative humidity data collected at Pueblo are presented in Table G-4. These data are the same as those discussed in Section 3.1.6.

Precipitation

As discussed in Section 3.1.6, precipitation which falls in southeastern Colorado is highly variable during the months from June to September. Precipitation data recorded at the Doherty Ranch, located a few miles northwest of the center of the study area, are presented in Table G-15. The total precipitation at Doherty Ranch averages 13.20 inches (33.53 cm) annually, but approximately two-thirds of the total precipitation normally falls during the five-month period of April through August. July is the wettest month with an average of 2.04 inches (5.18 cm), followed by May and August with 1.74 and 1.72 inches (4.42 and 4.37 cm), respectively. Precipitation is generally lightest in winter with January being the driest month. Daily precipitation amounts greater than or equal to 0.10 inch (0.25 cm) can be expected on an average of 29 days per year at the Doherty Ranch; amounts greater than or equal to 0.50 inch (1.27 cm) can be expected an average of only seven days per year (Table G-16).

Estimates of extreme precipitation that could occur in the study area are approximated by data from Doherty Ranch which show a maximum 24-hour total of 3.65 inches (9.27 cm) and a maximum monthly total of 5.20 inches (13.21 cm) (U.S. Department of Commerce, 1976). Estimated return periods for short duration precipitation in the study area are presented in Table G-17.

Summer rain is most often produced by thunderstorms which occur on an average of 41 days per year (Table G-8). Precipitation in winter and early spring falls mainly in the form of snow. From the Doherty Ranch data, the greatest average monthly snowfall of 6.1 inches (15.5 cm) occurs in March with the next greatest amount, 5.6 inches (14.2 cm), falling in January. The annual mean total snowfall at the ranch is 30.5 inches (77.5 cm). The greatest monthly snowfall amount recorded at Doherty Ranch was 30.0 inches (76.2 cm) in April (U.S. Department of Commerce, 1976).

Wind and Severe Weather

Long-term wind data are discussed in Section 3.1.6. Severe weather conditions would be similar to those at the Huerfano River Parcel.

Air Quality

The Pinon Parcel is located next to Otero and in Las Animas County, which are included in Colorado Air Quality Control Region (AQCR) 6 and 7, respectively. AQCRs are groups of counties which, for reasons of topography, meteorology, and other considerations, are treated as units for air pollution control. Federal ambient air quality standards presented in Table G-11 are the same in all AQCRs.

The state of Colorado promulgated ambient air quality standards for "designated" and "non-designated" areas in 1976. For the Pinon Canyon Parcel, the more stringent standards of the non-designated areas will apply.

Colorado Air Pollution Control Division and the U.S. Environmental Protection Agency have assigned priorities for controlling each major pollutant found in each AQCR. The priorities of the various pollutants in AQCRs 6 and 7 are shown below: (A Priority I pollutant is of more concern in a given region than a Priority II or Priority III pollutant.)

	AQCR 6	AQCR 7
Particulates	III	I
Sulfur Dioxide (SO_2)	III	III
Carbon monoxide (CO)	III	III
Nitrogen oxides (NO_x)	III	III
Hydrocarbons/oxidants (HC, O_x)	III	III

As discussed in the Huerfano River Parcel (Section 3.1.6) the state maintains several air quality monitoring stations in the vicinity of the Pinon Canyon Parcel. The stations closest to the training area are Rocky Ford, Trinidad, La Junta, and Walsenburg. Summarized particulate concentration data from these monitoring stations are presented in Table G-18.

The 1980 Colorado non-designated area standard, a maximum 24-hour concentration of 150 $\mu g/m^3$, was exceeded at all of the stations except Walsenburg and Trinidad. The 1980 annual designated area standard of 45 $\mu g/m^3$ was exceeded at all of the stations. It should be noted, however, that all of the samplers are at urban locations which are biased by urban influences and do not represent conditions in rural areas.

3.2.7 Sound

An ambient sound level survey was conducted at and near the Pinon Canyon Parcel area in order to document the existing ambient sound levels. Locations are shown on Figure 3-13. Details of the survey and results are described in Appendix H.

Ambient sound levels at nearby noise sensitive land use areas are typical of small communities and towns. Noise levels in these areas are dominated by traffic and animals. Wind and occasional overflying planes also contribute to the ambient sounds. A statistical summary of the ambient sound level measurements is presented in Table 3-25. Note that except at measurement Location 4, the present ambient day-night sound levels (L_{dn}) are below 55 dB, the level suggested by the federal Environmental Protection Agency as requisite to protect the public health and welfare.

3.2.8 Socioeconomics and Land Use

Population/Demography

The Pinon Canyon Parcel lies entirely in Las Animas County, but its proximity to Otero County means that both counties could be affected by acquisition of the parcel. Las Animas County is one of three counties in State Planning and Management District 7, and Otero County is one of six counties in State Planning and Management District 6. The population of both counties has grown slightly between 1970 and 1979 (Tables I-14 and I-15). The 1979 estimated population of Las Animas County was 15,770 and for Otero County it was 23,563. Population densities are lower than the state average of 25.7 persons per square mile, with 18.4 per square mile in Otero County and 3.3 per square mile in sparsely settled Las Animas County. The area of the Pinon Canyon Parcel has a very low population density, approximately one person per 11.2 square miles.

The Las Animas County population is concentrated in Trinidad which has 62 percent of the county population. The population of Otero County is dispersed more evenly through several small communities, of which La Junta is the largest with 35 percent of the county population. Rocky Ford with 4500 people has 19 percent of the county population, while Fowler is third with 4 percent of the population.

The vital statistics for these two counties (Table I-16), indicate a slightly lower birth rate and much higher death rate than for Colorado as a whole, largely due to the higher median age of the population. The Las Animas County median age is 32.0 years and Otero County has a 28.3 year median age, compared with a median age of 26.2 years for the whole of Colorado. The lower birth rate and higher death rate contribute to the relatively slow growth rate of the two counties.

TABLE 3-25

SUMMARY OF AMBIENT SOUND LEVELS
(WEEKDAYS)

Locations	Daytime (0700-2200)	Nighttime (2200-0700)	
1	05/21/77 1300	05/21/77 2240	
L_{90}	36	23	
L_{50}	43	24	
L_{10}	50	27	
L_{eq}	46.3	25.3	
L_d			46.3
L_n			25.3
L_{dn}			44.2
2	05/21/77 1415	05/21/77 2355	
L_{90}	32	22	
L_{50}	34	24	
L_{10}	42	40	
L_{eq}	39.0	37.1	
L_d			39.0
L_n			37.1
L_{dn}			43.8
3	05/21/77 1625	05/22/77 0135	
L_{90}	33	18	
L_{50}	35	18	
L_{10}	38	19	
L_{eq}	36.8	18.5	
L_d			36.8
L_n			18.5
L_{dn}			34.8
4	05/21/77 1732	05/22/77 0037	
L_{90}	31	49	
L_{50}	36	51	
L_{10}	41	56	
L_{eq}	40.0	52.4	
L_d			40.0
L_n			52.4
L_{dn}			58.1
5	05/21/77 1810	05/22/77 0210	
L_{90}	38	24	
L_{50}	43	35	
L_{10}	48	46	
L_{eq}	45.0	42.3	
L_d			45.0
L_n			42.3
L_{dn}			49.2

Population projections have been developed through 1990, based on 1970 through 1977 population estimates (Table I-17). Otero County could have up to a 10.2 percent increase while Las Animas is projected to have between a 15 percent decrease and a 20.01 percent increase in population in the next decade. Projections for both counties indicate a slower growth rate than for the state as a whole, which is projected to grow between 24 and 48 percent during the same period.

Economic Base

Both Las Animas and Otero Counties have well balanced economies with all industrial sectors well represented as shown by employment statistics (Table I-18). The employment patterns are characteristic of the state, with government the leading source of employment with 31 percent in Las Animas County and almost 20 percent in Otero County, followed by the service and trade sectors.

Otero County has more manufacturing activity and more manufacturing employment than Las Animas County. This activity is dispersed through the small communities along the Arkansas River, whereas in Las Animas County 76 percent of the manufacturing is concentrated in Trinidad. In Otero County, Rocky Ford has 45 percent and La Junta 39 percent of the manufacturing establishments (derived from Table I-19). These figures represent a slight decline in number of manufacturers, between 1976 and 1979. The overall income to the counties has not been reduced however, due to economic expansion in other areas. (University of Colorado, Business Research Division, 1979). Retail sales (Table I-20) for Las Animas County and Trinidad were down somewhat for 1979 as compared with 1978. Between 1976 and 1979, however, sales have risen overall for the area. Sales in Otero County rose during the same period (University of Colorado, Business Research Division, 1979).

The rural character of these two counties represents a thriving agricultural industry in addition to the more typically urban sources of employment. A large percentage of overall income for both counties is derived from agriculture. Farming and ranching are the basis for much of the higher employment statistic in the trade category, as well. Production is shown for all agricultural categories (Table I-21). The total values of crops produced (Table I-22) in 1978 was $16.7 million in Otero County which represented 2.2 percent of the state's production values. A value of almost $1.5 million in Las Animas County represented 0.2 percent of Colorado's production value (Colorado Department of Agriculture, 1979). Otero County is the source of a great variety of crops, fruits and vegetables, while cattle grazing is the mainstay of Las Animas County.

Cattle ranching/grazing is the primary agricultural activity in the vicinity of the parcel. The total inventory of cattle for both counties in 1979 represented 4.3 percent of the state's total which is only slightly down from the 1978 levels of production. Based on the average number of acres per animal unit in Las Animas County and the recommended carrying capacity of the land, the parcel could support between 3675 and 4854 cattle. The value of those animals would range between 2.7 and 3.6 million dollars, based on a market weight of roughly 1000 pounds at $75.00 per hundred weight.

The annual productivity of these animals is worth between .88 and 1.4 million dollars depending on such variables as markets, weather and forage availability. This estimate is based on grazing carrying capacity between 53 acres per animal unit (actual practice in Las Animas County and in the parcel·area) and 70 acres (recommended level for range conservation), with an average 80 percent calf crop of between 2940 and 3883 calves. The average market value per calf is $300 to $350 when sold to feeder operations. The land in Unit F could support an additional 643 to 843 cattle with annual productivity worth between $155,000 and $237,000.

The minerals investigation report conducted for this study indicates slight potential for some low grade uranium, as well as some natural gas or petroleum, but no economic deposits of any of these have yet been discovered in Las Animas County. All of the current mining activity in Las Animas County is located outside of the Pinon Canyon Parcel in the western portion of the county and it is not anticipated that economic mineral deposits will be present within the parcel.

The general economy in Las Animas and Otero Counties is good. There is a slow growth trend, and the diversity in economic base of these two counties should prevent a repetition of the economic slump experienced in Las Animas County from 1920 to the 1960s when the single-industry based economy weakened, as coal mining decreased.

Per capita income has been steadily increasing since 1974 (Table I-23). Las Animas County income levels have increased slightly more than the state average of 23.1 percent and Otero is only 0.2 percent below the state average increase at 22.9 percent. Actual levels of income still lag behind the state averages, but the increases are good indicators.

Unemployment rates for both counties were above 4 percent (Table I-24). This is higher than the state average in 1979, but below the national rates for that year. The total of 14,888 jobs represented 1.1 percent of the total number of jobs available in Colorado for 1979.

The total assessed valuation of Otero and Las Animas counties, as of 1978, was $100.3 million, $40.7 million in Las Animas County and $59.6 million in Otero County (Table I-25). Total revenue recognized from total property tax levies was $3.2 million in Las Animas and $4.5 million in Otero in 1978 (Colorado State Division of Property Taxation, 1979). The tax revenues realized from the area of the parcel is about $59,200 annually, based on the assessed valuation of grazing land. Of this, about $25,000 accrues to the Hoehne School district which has over a quarter of its land included in the parcel.

Land Use Aspects

The proposed Pinon Canyon parcel, located in north central Las Animas County, covers one of the most sparsely populated areas of Colorado. The 302,205-acre (122,302 hectares) site is approximately 40 miles northeast of Trinidad, 73 miles from Walsenburg, and 115 miles from Pueblo. The parcel is 150 miles southeast of Fort Carson. The entire area is used for cattle grazing and is zoned for agricultural use. The surrounding areas contiguous to the parcel are similar range grazing land.

Several small communities are located along U.S. Highway 350 in the vicinity of this parcel. These are Model, Tyrone, Simpson, Thatcher, Houghton, and Delhi, all of which have populations of less than 50. Highway 350 forms the western boundary of the parcel roughly between Simpson and Thatcher. The cantonment for this parcel would be located near the Thatcher rail siding for the Atchison, Topeka & Santa Fe (A.T.& S.F.) Railroad. Hoehne is about 28 miles southwest of the parcel, but no other communities exist in the area.

The predominant land use in both Las Animas and Otero Counties is agriculture, primarily grazing (Table I-26). In Las Animas County, irrigated crops are grown along portions of the Purgatoire River and northeast of Trinidad near Hoehne. Most of the remainder of the county is dryland, with forest area in the western portion of the county. In Otero County, the irrigated land along the Arkansas and Purgatoire Rivers supports a variety of grain and fruit crops, but the majority of the agricultural land use is dryland grazing, which is the only land use on the parcel (U.S. Soil Conservation Service, 1976). The areas devoted to urban land uses are relatively small compared to the entire area of the county. In Las Animas County, Trinidad is the largest city but there are a number of smaller communities and developing areas in the western portion of the county (Huerfano-Las Animas Council of Governments, 1976).

In Otero County, the urban land uses are concentrated in the Arkansas River Valley. The remainder of the county is primarily rangeland, with the southern half occupied by the Comanche National Grassland, which forms the northern boundary of the Pinon Canyon Parcel.

The unique and spectacular landforms of the canyons cut by the Purgatoire River and its tributaries have caused interest in this area which borders the eastern edge of the proposed Pinon Canyon Parcel. The Red Rock Canyon area and portions of the Purgatoire River Valley have been under consideration by the Colorado Division of Parks and Outdoor Recreation for acquisition as a state park since the late 1960s. The Nature Conservancy has proposed that this area become a conservation area, but the funds have not been available to buy and convert the area from its present grazing use.

The most recent action concerning this area is the inclusion of about 60,000 acres (24,282 hectares) (Figure 3-6) on the list of sites to be designated as a National Natural Landmark by the Secretary of Interior (Federal Register, vol. 45, no. 4, January 7, 1980). The original Natural Landmark Brief (1975) indicated that 90,340 acres (36,572 ha) would be included. The HCRS has requested a deferment on designation of this area pending further study of the site.

Existing Transportation Facilities

The primary highway transportation routes between Fort Carson and the Pinon Canyon Parcel are Interstate 25 (I-25), U.S. 50 between Pueblo and La Junta, and U.S. 350 between Trinidad and La Junta. There are several county roads which extend south from the communities along U.S. 50, such as Colorado highways 167 south of Fowler and 71 south of Rocky Ford. Railroad transportation is available on the Colorado and Southern/ Denver and Rio Grande Western tracks, which roughly parallel I-25 from north to south. The A.T. and S.F. railroad has an east-west spur line from Pueblo to La Junta; the main line track runs northeast/southwest between La Junta and Trinidad.

3.2.9 Cultural Resources

Historic, archaeological and cultural aspects of the proposed Pinon Canyon Parcel are important issues. The area in the Purgatoire River Canyon is a geologically unique structural arch with eroded surfaces. It also contains Indian cultural remnants from early to recent time. Such things as petroglyphs, pictographs, chipping stations, stone structures and other evidence of early man sites are abundant in the area. The State Archaeologist's files show many sites in Las Animas and Otero counties though few have been identified on the lands proposed for Army acquisition since the state inventory is maintained primarily for public lands (Table 3-26). It is believed that there are many additional sites, but with over 80 percent of the land area in private ownership most have not been explored and documented. The locations of these sites are identified only by township and range (and occasionally by section) in part to prevent access and possible disturbance by unauthorized persons. The list of identified sites is included on Table 3-26.

The Purgatoire River valley is distinguished by unusual red rock formations and spectacular canyon walls. Over 60,000 acres (24,282 hectares) including the Red Rocks Canyon in the river valley has been included on the list of sites proposed for designation as National Natural Landmarks. A delay in designation has been recommended by the Heritage Conservation and Recreation Service (HCRS) pending the completion of the Army studies and further inventories by local archaeologists and geologists.

Sites of historical significance located on or near the Pinon Canyon Parcel include the Barlow and Sanderson Stage Line and Rourke

TABLE 3-26

ARCHAEOLOGICAL AND RECENT HISTORICAL SITES - PINON CANYON PARCEL

ARCHAEOLOGICAL SITES:

Source: State Archaeologist's Files

Las Animas County

T29S, R56W - 5 sites
T30S, R56W - 3 sites
T35S, R56W - 1 site

Many other sites are listed for Las Animas County but cannot be located due to improper recording of Township and Range. The field work will have to be conducted again.

Otero County

No sites are listed

RECENT HISTORIC SITES:

Source: Colorado Inventory of Historic Sites, Oct. 1976

Las Animas County

Barlow and Sanderson Stageline	T27-34S, R56-64W, Many Sections
Rourke Ranch	T28S, R56W, S24 NW 1/4
Long Expedition	T26-35S, R59-61W, Many Sections
Martin Bowden Paintings: on cliff walls in Purgatoire Canyon - No location given	

Otero County

No historic sites are located along parcel boundary

Ranch. The Long Expedition is known to have traversed this area as well. These sites have not been included in the National Register of Historic Places, but have been designated by the State Historical Society of Colorado as potentially eligible for inclusion in the National Register (see Table 3-26 for locations). With the exception of buildings at the Rourke Ranch few traces of the recent historical activity remain on the parcel.

Awareness of these sites is being included in the consideration of this parcel. These special aspects will be discussed at greater length along with suggested mitigation procedures in the impacts discussion section of the environmental impact statement.

4.0 ENVIRONMENTAL CONSEQUENCES

4.1 HUERFANO RIVER PARCEL

Military training on the parcel would be conducted according to the Land Use and Management Plan discussed in Section 2.5. Military use of the Huerfano River Parcel would alter existing environmental characteristics of the parcel. Beneficial and adverse impacts are assessed in this section, and measures to mitigate adverse impacts are described. Impacts were assessed for the parcel for the area within the preferred boundaries. Impacts resulting from military training activities would be essentially equal for the area included within the offered boundaries.

Impacts were assessed on the basis of the LUMP and the Balanced Use/Protection Scenario, which represented the mid-level of military training use and protection of the land resource (Figure 2-2). Impacts resulting from training levels in the Increased Use and Increased Protection Scenarios were compared to those that were determined for the Balanced Use/Protection Scenario. The air quality impacts, however, were determined on the basis of worst-case conditions, which would be represented by the Increased Use Scenario. After these impacts were assessed, it was concluded to present the Increased Use Scenario as the preferred course of action.

4.1.1 Geology/Minerals

Proposed military activities associated with the acquisition and use of the Huerfano River Parcel would have little effect on the geology of the area regardless of the scenario used. The parcel contains no unique geologic features. In addition, the geologic formations exposed in the parcel are widely distributed and have no special stratigraphical or paleontological significance.

The only probable impact of the proposed military activities would be the removal of about 225,000 acres (91,058 hectares) from future exploration for mineral and fuel resources. According to the Colorado School of Mines Research Institute (1980), current mineral reserve estimates indicate that uranium is the only mineral resource commodity that may be affected by land withdrawal. However, according to the Colorado State Board of Land Commissioners, the area under lease for limestone development (Section 3.1.1) would be affected by land withdrawal. Acquisition of this area for maneuver training would preclude limestone development. The only practical mitigation of this impact would be not to acquire the leased area (Figure 3-1), however, a decision to remove the leased area from consideration for acquisition has not been reached.

4.1.2 Soils

Training Use

The impact of training on the soils of the Huerfano River Parcel would depend upon the pattern and intensity of use on the landscape. A generalized training scenario is described in Section 1.4.5; however, actual use patterns would emerge as training is accomplished on the parcel and may differ from this generalized scenario.

In general, training activities would result in scattered areas with moderate to extreme impact and large areas with slight or negligible impact. Areas of moderate to extreme impact would increase according to the number of exercises conduted during a given rotation period.

The Sandstone Breaks (SB), Limestone Breaks-Loamy Plains Complex (PmE), Limestone Breaks-Pinyon-Juniper Complex (PR) and trafficable portions of the Pinyon-Juniper-Rockland Complex (TrG) units would experience the heaviest training use due to topographic dominance and availability of strategic cover. The Alkaline Plains (AP) and Shaly Plains (SP) units would also be affected heavily due to close proximity to the limestone cliff areas.

Soil Impacts Resulting From Loss of Vegetative Cover

Disturbance of vegetative cover, although not a direct impact on the soils, would expose the soils to erosive forces. Each mapping unit of the parcel has unique cover that protects the surface. This cover includes not only live vegetation but plant litter, rock cover and rock outcrops. These types of cover show varied response to disturbance. Generally only vegetative cover is destroyed by maximum traffic disturbance. Existing effective cover and residual cover that remains if all vegetative cover is destroyed is summarized in Table 4-1 (see Appendix C for further details).

The most useful units for training activities have the best natural residual rock cover, and soil surfaces on these units would be partially protected even with maximum disturbance. However, most of these mapping units do not respond well to treatment measures (see stability rating discussion, Section 2.4.2) and their steeper slopes make them susceptible to accelerated water erosion (see Figure 3-3 in Section 3.1.2).

Vehicle activity would result in reduced vegetative cover, as discussed in Section 4.1.3. The loss of vegetative cover on soils of the parcel would expose the soil surfaces to the erosive forces of both wind and water. Soil susceptibility to water erosion and wind erosion varies greatly for each soil range mapping unit on the parcel as illustrated in Figures 3-3 and 3-4, Section 3.1.2.

TABLE 4-1

AVERAGE COVER OF MAPPING UNITS, HUERFANO RIVER PARCEL

Mapping Unit Symbol	Range Site Component	Existing Cover of Vegetation, Rock, and Litter (percent)	Residual Cover of Rock and Litter (percent)
LP	Loamy Plains	31.5	7.5
SB	Sandstone Breaks	42.0	26.0
PR	Limestone Breaks-Pinon-Juniper Complex	58.0	30.0
PmE	Limestone Breaks-Loamy Plains Complex	57.0	40.0
SO	Saline Overflow	35.0	7.0
TrG	Pinon-Juniper-Rockland Complex	64.0	40.0
AP	Alkaline Plains	28.0	9.0
SP	Shaly Plains	29.0	10.0
SM	Salt Meadow	46.0	13.0

In general, soil-range units in moderately and steeply sloping areas would experience the highest water erosion losses. This includes most of the mapping units considered useful for military training and therefore likely to receive the highest proportion of severe and extreme impacts. Mitigation measures described in the LUMP, including construction of diversion channels, sedimentation dams and other surface and channel flow retarding measures, would significantly reduce impacts and confine sediment to localized areas.

Wind erosion losses would be the greatest in the open plains, including soil-range units LP (Loamy Plains), SO (Saline Overflow), AP (Alkaline Plains) and SP (Shaly Plains). The soils in these areas have low residual surface cover and few barriers to reduce ground level wind speeds. The anticipated severe and extreme impacts on these units would be in topographic bottleneck areas, bivouac areas, on lands adjacent to topographic features, and in newly emerging trails prior to application of mitigating measures.

As discussed in the LUMP, areas of high intensity use which experience serious reductions in vegetative cover would either be protected with gravel, hay or other cover to allow continued use or the vegetative cover would be restored to an acceptable level with mitigation measures during enforced non-use.

Physical Soil Impacts Resulting from Training Use

Several direct physical impacts to the soil would result from overland traffic movement. These include compaction of the soil, formation of ruts, and pulverization of the surface crust. Compaction on a majority of the units which have silty or stony surfaces would be minimal under the dry conditions common to the parcel. Moderate to extreme compaction would occur on the Alkaline Plains and Shaly Plains sites under all moisture conditions. Mitigative measures such as pitting might be required if traffic was concentrated on either unit. The mitigation would partially reduce the increased soil runoff and water erosion caused by compaction and rutting. Compaction and rut formation on the remaining sites would be reduced by cessation of training on the parcel when the soil moisture is excessive, as specified in the LUMP. On soils adjacent to water bodies, wet conditions may be encountered during normal use. These areas would require close monitoring and mitigation to retard gully formation.

Pulverization of the usual protective surface crust occurring during dry conditions would be an unavoidable impact. In silty arid soils surface crusts form after wetting and partially stabilize the surface against wind erosion losses. Pulverization would provide many fine particles for wind erosion, hence the increased erodibility of the surface would continue until the soil is again wetted. This short term moderate impact would occur on all areas experiencing traffic movement. A short term mitigation to reduce blowing could include wetting the surfaces experiencing severe blowing to aid in crust formation. Long term treatment measures such as mulching, gravelling or pitting could later be applied. Recovery also takes place with natural precipitation.

Where repeated vehicular passes are frequent enough to form obvious trails, protective measures discussed in the LUMP would be applied. Therefore, major trails would contribute to erosion losses only until they are mechanically treated. Until treatment occurs, the trails would cause severe to extreme impacts. Minor trails would remain untreated until erosion is evident or treatments are applied. These minor trails would be the cause of severe land impacts and would contribute to erosion losses until treatment was applied. Concentrated severe and extreme impact areas near dominant terrain features would be treated when they became large enough to be inventoried by conservation monitoring. The surface characteristics of the training lands would change slowly; conservation measures and surface treatments would replace natural vegetative cover in areas of high use. The range in effectiveness of these surface treatments would depend upon the thoroughness and timeliness of application. Generally the measures would not stabilize the land as effectively as the natural cover.

Isolated areas of tracked vehicle turns away from any major terrain objective would be difficult to mitigate. Wind erosion losses of soil in these areas would increase only slightly, because cover adjacent to the turn scars would protect the soil. Water erosion losses would range from slight to moderate, depending on the orientation and landscape position of the turn scar. Turn scars, especially those turns oriented up and down hill in moderately sloping, non-stony soils, would be the most easily eroded. Vegetative disturbance within the scars would probably be extreme, precluding adequate reinvasion by nearby plants during a 3-year rest period. Timely application of seed by seed dribblers, as outlined in the LUMP, would supply a source for reinvasion by suitable grasses. However, this would not result in a revegetative cover equal to the natural cover.

In the Increased Use Scenario, full recovery in the majority of impacted lands (those with severe impacts resulting in partial vegetative cover reduction) would occur only in years with adequate and timely precipitation. Areas of extreme impact would require artificial surface protection or intensive reseeding. Reseeding failure would be higher due to a 2-year establishment period before repeated use, and eventually some areas might require cessation of use to allow recovery. The number of unimproved trail roads would be significantly higher. Tracked vehicle scars would continue as the most long lasting unmitigated impact. Due to the shorter rest-recovery period, gradual degradation of the entire land resource would be expected.

In the Increased Protection Scenario, Unit A would not be used for training purposes, reserving a significantly large portion of the parcel for optimum vegetative cover and soil development. The deferment during periods of drought would aid significantly in assuring recovery from use. Impacts on the units being used can be expected to be about equal to those in the Balanced Use/Protection Scenario.

Table 4-2 shows the amount of land that could be expected to be impacted for a single unit and the proportion of the entire parcel that this amount represents for each scenario. Negligible and slight impact areas will gradually improve from the present condition because of the removal of grazing impacts. Moderately impacted areas would remain at the present state, as moderate random use would approximately equal the present grazing impacts. Areas of severe and extreme impact would contribute most of increased sediment from water erosion losses and the particulates due to wind erosion due to significant reductions in vegetative cover.

4.1.3 Vegetation

General Impacts

Historical use of Plains Grasslands and resulting impacts of grazing, drought, fire and plowing have been studied and documented almost from the beginning of settlement (U.S. Great Plains Council, 1936; Sears, 1935). The Dust Bowl of the 1930s was the dramatic manifestation of the consequences of the loss of the protective vegetative cover of the Great Plains (see Table D-22 which shows also that low precipitation during that period contributed to dust bowl conditions).

TABLE 4-2

PREDICTED IMPACTS FOR THE ENTIRE HUERFANO RIVER PARCEL[a]

Use Scenario	Levels of Impact on Land Disturbed (percent)[b]				
	Negligible	Slight	Moderate	Severe	Extreme
Increased Protection	35	19	19	19	8
Balanced Use/ Protection	21	17	22	31	9
Increased Use	17	13	22	35	13

[a]Includes all off-limits and restricted use areas which will experience negligible impacts.

[b]Net change in existing vegetative cover.
Negligible + 20 percent
Slight + 10 percent
Moderate - 0 percent
Severe -> 40 percent
Extreme -> 80 percent.

Much evidence is available concerning influences of various disturbances, such as grazing and farming, on plant cover in an arid region similar to the parcel. However, little documentation exists concerning the effects of mechanical injury to plant cover and especially to the impact of vehicular traffic. Interpretations of the principles of plant growth and development are necessary for understanding impacts of vehicular traffic on the vegetation. These principles are discussed in the following sections under type of vegetation.

Impacts on vegetation as a result of vehicle traffic disturbances are both direct and indirect. Direct impacts destroy plant parts, both above and beneath the ground surface. Indirect types of impacts result from the pulverizing of soil or the compaction of soil, depending on soil moisture at the time of disturbance. Such soil changes inhibit vegetative growth. A potential indirect impact is the coating of plant leaves with dust, thus inhibiting growth by clogging their pores (stomata) and restricting the full exchange of carbon dioxide and water vapor.

Vehicle activity would cause three types of disturbances which would result in reduced vegetative cover. Repeated passes by tracked or wheeled vehicles across rangeland would result in a decrease in vegetative cover. It is estimated that three passes over the same path on Medium stability lands by tracked or wheeled vehicles equals a 25 percent reduction in plant cover for tracked vehicle passes and a 35 percent reduction in plant cover for wheeled vehicle passes (Personal communication, Roy Cammack, SCS, January 29, 1980).

The second type of vegetative cover disturbance would result from sharp turns by tracked vehicles. Panic turns, which are nearly full circle turns performed as rapidly as possible, usually result in the loss of a track. These turns, therefore, would be unlikely under most training conditions. Other sharp turns, such as medium-speed half-circle turns, can be expected to occur occasionally in heavy tree-cover areas such as in areas of Pinyon pines and One-seed Junipers. Fines for tree damage are levied on Army personnel so thus they will turn away from trees if possible. These can be expected to disturb from 50 to 60 percent of the plant coverage (Personal communication, Roy Cammack, SCS, January 29, 1980). Although these turns would comprise only a fraction of the overland tracked vehicle mileage, they can be expected to cause extreme impacts on the vegetative cover in the high concealment areas of the parcel.

The third type of disturbance would occur in bivouac areas for brigades and battalions. Brigade headquarters would be moved three to four times per training period and would require concealment to remain militarily viable. Therefore the number of vehicles traveling to the headquarters would be kept to a minimum and established trails would be used whenever possible to avoid aerial recognition. Battalion headquarters would be moved often (up to 20 times per training period), and the concentrated use would be shortlived. Both of these activities would cause concentrated extreme impacts on small areas.

Areas of the parcel where training would be concentrated could experience significant plant ground cover losses. Essentially these high impact areas include the following mapping units: Sandstone Breaks (SB), Limestone Breaks-Loamy Plains (PmB), Limestone Breaks-Pinyon-Juniper Complex (PR) and the Pinyon-Juniper-Rockland Complex (TrG). These areas offer preferred training features; however, a significant portion would fall within the off-limits areas and thus would be inaccessible to mechanized traffic (see Figure 3-5 and Table 3-2).

Vegetative ground cover losses in these high impact areas could be as great as 75 percent in areas where wheeled vehicles pass over the same path of Low stability ground at least three times in a single year. However, this high percentage of ground cover loss is expected to be primarily limited to bivouac sites. Impacts on vegetation in mapping units other than those receiving intensive use would be noticeable, particularly in the Low or Very Low stability areas, but not as significant since in most instances only sporadic and occasional use would occur. Extreme impacts on the land would result from isolated sharp vehicular turns where from 50 to 60 percent of the vegetation can be lost.

Table 4-3 contains estimated percentages of land in training units that would experience varying levels of impacts. This reflects only land available for maneuver training. Present levels of impact on the land are moderate, due to grazing. Negligible and slight impacts would therefore constitute an improvement over existing conditions. Extreme impacts are the same for the Balanced Use/Protection and Increased Protection Scenarios because training exercises would concentrate on the same terrain objectives regardless of scenario. About 25 percent of the parcel will remain in moderate condition regardless of scenario, with military training resulting in an impact level essentially the same as present conditions.

TABLE 4-3

PREDICTED LAND DISTURBANCE
BY MILITARY TRAINING OPERATIONS[a]

Use Scenario	Levels of Impact on Land Disturbed (percent)[b]				
	Negligible	Slight	Moderate	Severe	Extreme
Increased Protection	15	25	25	25	10
Balanced Use/ Protection	10	20	25	35	10
Increased Use	5	15	25	40	15

[a]Includes land that would actually be used for military training. Does not include off-limits and restricted use areas.

[b]See Table 4-2, page 4-6, footnote b.

Grazing

Grazing could be permitted in limited low use or military off-limit areas; the grazing program would be evaluated on an experimental basis, as discussed in Section 2.5. Overall it is expected that grazing would be severely limited to optimize land recovery. In general, grazing inhibits recovery due to the selective removal by cattle of succulent vegetation, cattle trail damage, and similar ground and vegetation degradation around stock water areas. However, it has been experienced that grazing under management can stimulate growth of perennial grasses. If the experimental program prohibits or inhibits vegetative growth in any substantial way, grazing would be discontinued.

Impacts on the Major Grasses

Blue grama, galleta, western wheatgrass, and other perennial grasses that grow on the parcel have special physiological and morphological features that enable them to tolerate grazing use and endure drought.

These features are not wholly effective, however, in protection from mechanical injury caused by vehicular traffic.

A perennial grass produces all new above-ground plant parts every year. Above-ground parts are therefore equivalent to annual species. The greatest continued concentration in growth of a grass is in the roots. This growth depends on top growth and nutrient production, hence removal of leaves directly affects grass production.

The 14 most frequently occurring grasses on the parcel and their reproductive capabilities (Appendix Table D-11) are rated in Table 4-4 according to their anticipated tolerance to traffic disturbance. None of the grass species have both combined high vegetative and seed reproduction qualities. The two most frequently occurring grasses on the parcel are blue grama and galleta. These grasses are rated 1 and 4 in Table 4-4 for their overall tolerance to traffic disturbances. These two grasses would be highly valuable in the protection of the Management Units from degradation; it is therefore important to plan use of the Management Units to protect and promote the growth of these grasses.

TABLE 4-4

REPRODUCTIVE CAPABILITY OF GRASSES

Rating	Species[a]	Vegetative	Seed
1	Galleta	High	Low
2	Western wheatgrass[b]	High	Low
3	Saltgrass[b]	High	Low
4	Blue grama	Low	Low
5	Red three-awn	Low	High
6	Sand dropseed	Low	High
7	Side-oats grama	Moderate	High
8	Alkali sacaton	Low	High
9	Ring muhly	Moderate	Moderate
10	Bottlebrush squirrel-tail	Low	High
11	New Mexico feathergrass	Low	Moderate
12	Hairy tridens	Low	Moderate
13	Silver bluestem	Low	Moderate
14	Little bluestem	Low	Moderate

[a]Species listed in descending order of tolerance to traffic disturbance.
[b]Best adapted to lowland sites.

Sod-forming grasses characteristically spread laterally and increase ground covered by a parent plant. This characteristic is known as vegetative reproduction. Sod is formed by means of either underground runners (rhizomes) or above-ground runners (stolons). Sod-forming grasses such as galleta, with underground runners, are protected by a soil covering. Blue grama has neither rhizomes nor stolons but spreads to a limited extent by lateral buds or tillers. As a general rule the sod-forming grasses are more tolerant of traffic than the bunch grasses.

Bunch grasses do not have vegetative reproduction and can extend their territory only by seed production and dispersal. Bunch grasses are easily destroyed by surface disturbance because they are solely dependent on the growth of a single-unit parent plant.

Table 4-5 shows predictions of impacts related to dust cover and mechanical injury on perennial grasses. Sod-forming grasses, such as galleta, western wheatgrass and saltgrass, are more tolerant of mechanical injury than the bunch grasses, such as blue grama. Impacts on bunch grasses are predicted to be more serious for longer time periods than on the sod-forming grasses. Impacts on grasses caused by dust cover are predicted to be equal, although the sod-forming grasses have the advantage over bunch grasses because of underground runners.

Impacts on the Major Forbs

Predicted impacts of military vehicle traffic on forbs of the parcel are presented in Table 4-5. Fremont goldenweed, Colorado four o'clock, blackfoot, zinnia and germander are representative native perennial forbs of the parcel. Impacts caused by dust cover can be expected to be more serious on forbs than on grasses. The leaves of forbs are broader with more surface area and their growing points are elevated above ground, while growth of grasses is from near or at ground level. Forbs will be subjected to moderate impacts from mechanical disturbance for both immediate and long-term duration. Their recuperative ability is aided by the establishment of plants from seeds combined with renewal of growth from roots.

Cholla, a cactus with tree-like growth, forms colonies on Loamy Plains and other range sites of the parcel. Cholla are important escape and resting cover for Scaled Quail. Although the plant becomes established from seed and from sprouting in favorable years it is slow to make adequate height growth for quail. It has been estimated that 10 to 40 years are needed for cholla to reach 4 feet height under rangeland conditions.

Impacts on Trees and Shrubs

Shrubs and trees of the parcel that have special prominence include one-seed juniper, pinyon, cholla, Bigelow sagebrush, fourwing saltbush and Frankenia. Growing points of trees and shrubs are elevated above the soil surface. The juniper and pinyon die if the stem is broken off at the ground line, and will not resprout. The other shrubs can all renew growth from the ground if the above-ground parts are destroyed. Because tree and shrub areas would be focal points for maneuver activities, most new growth would probably be affected and possibly terminated (Table 4-5). Older trees and shrubs may experience loss of productivity,

TABLE 4-5

PREDICTED IMPACTS OF MECHANIZED MILITARY TRAINING OPERATIONS ON THE VEGETATION

Perennial Plant Species	Impact from Dust Cover	Mechanical Injury: Immediate Impact <3 Years[a]	Mechanical Injury: Long Term Impact >3 Years[a]
Grasses[b]			
Bunch grasses	Moderate	Severe	Moderate
Sod-forming grasses	Moderate	Moderate	Slight
Forbs[b]	Severe	Moderate	Moderate
Trees and Shrubs			
Pinyon and Juniper	Moderate	Extreme	Severe
Four-wing Saltbush	Moderate	Extreme	Moderate
Winterfat	Moderate	Severe	Moderate
Rabbitbrush	Moderate	Moderate	Slight
Skunkbush	Moderate	Moderate	Moderate
Snakeweed	Slight	Slight	Negligible
Cholla	Slight	Extreme	Severe
Yucca	Slight	Slight	Slight

[a]See Table, Appendix D.

[b]Estimates are for the duration of the impacts to individual grasses, forbs, trees and shrubs. The destruction of an individual bunch grass, for example, would result in the loss of that individual plant for at least three years. A replacement for the bunch grass would go through stages of seed germination, establishment and root development before it became equivalent to the plant removed by surface disturbance. In a semi-arid climate a minimum of three years would be needed for the replacement.

because increased erosion may result in long-term losses of available nutrient reserves.

Some shrubby species, including the half shrubs of winterfat and snakeweed, can survive moderate traffic disturbance. They are adapted to produce new above-ground growth each year, and will continue to exist in disturbed areas. Yucca is not a true shrub nor is it classed with grasses or forbs. Yuccas are strongly rhizomatous and have the capability to regenerate from underground plant parts. They can also be expected to maintain a population on disturbed areas.

The severity of disturbance to the plant cover, even under the least intense and most beneficial time schedule of the scenarios, will require constant monitoring, prompt conservation treatment and necessary followup to mitigate damages. Applicable conservation measures are described in Section 2 and Appendix D. There are no other feasible enhancement and protection measures which could reasonably be applied to mitigate the effects of training use of the parcel.

Endangered Plant Species Protection

A native forb, Fremont goldenweed and its subspecies Haplopappus fremontii monocephalus occurs, or may be expected to occur, on Shaly Plains, and to a lesser extent on associated sites, in the Huerfano River Parcel. The Shaly Plains range site, 3,120 acres (1,263 hectares), is classed in the Very Low site stability category. This land area would not be used for any military training. The Endangered Plant Species status for the subspecies was designated in the Federal Register list of June 1976.

4.1.4 Hydrology

Surface Water Impacts

Sedimentation

The most significant potential impact on surface waters in the Huerfano River Parcel would be increased sediment loading which would occur from:

1) Increased sheet or rill erosion from surface runoff;

2) Increased channel erosion from river/stream crossing activity; and

3) Settling of fugitive dust.

Of these sources, the greatest long-term contribution of sediment would probably result from increased sheet or rill erosion from surface runoff, particularly in areas where training activities are concentrated on areas of variable relief.

Degradation of the topsoil and reduction of ground cover vegetation by vehicular traffic would be the principal causes of increased erosion. Ground pressure from wheeled and tracked vehicles pulverizes the soil crust and increases the availability of soil particles in runoff water. Plants help to control or limit erosion. Plant roots hold the soil in place while leaves act as miniature barriers and deflectors that inhibit the downslope movement of soil and water. Furthermore plant leaves reduce the impact force with which water drops strike the ground surface, thus reducing soil displacement. On a cumulative basis, vegetation constitutes a major factor for soil stability and is integral to limiting erosion and sedimentation. Accordingly, in areas where more than 75 percent of the ground cover vegetation is lost (see Section 4.1.3), topsoil would also be severely disturbed. The potential for increased sedimentation would therefore be greater.

Potentially increased sediment loading would also occur at river/stream crossing locations, particularly during flow conditions and when bottom sediments and channel bank materials are loosened and readily available for transport in runoff water. Incremental increases in potential sediment loading would also result from fugitive particles when dust settles on surface waters.

Projected maximum increases in sedimentation potential due to military training and related activities were estimated for anticipated average annual runoff conditions in each major watershed area (Table 4-6). Levels of impact are also noted. The calculations were based on predicted gross erosion rates for assumed 30 percent locally disturbed conditions with reduced cover (Table C-7) and an appropriate area-sediment delivery ratio, as discussed in Appendix E. Increased sediment loads in the parcel would be potentially maximum under the Increased Use Scenario; however, the potential incremental increase in sediment load would be limited for the most part to the Management Unit and the actual acreage selected for use in any given training year. The runoff, erosion and sediment control measures, and channel bed and bank protection measures outlined in the LUMP would provide some control for transportation of sediment within given watersheds within the parcel and limit sediment delivery outside the parcel boundaries.

Salinity

Increased salinity in surface waters in the Huerfano River Parcel would also be anticipated from military training activities. This would result as a secondary effect from increased erosion on the parcel and sediment loading in surface waters. Surface water salinity problems, that occur in this region are generally attributable to the high rate of evaporation. After a rain shower, even with efficient soil infiltration, moisture migrates to the surface and evaporates, leaving the salts and minerals behind. As a consequence, salts either adhere to or form a chemical bond with soil particles. If these soil particles are later released to the surface waters, the salts will dissolve and create a condition known as hard water or high alkalinity.

TABLE 4-6

PROJECTED POTENTIAL MAXIMUM LOCAL SEDIMENT YIELDS IN MAJOR WATERSHED AREAS WITHIN PREFERRED BOUNDARY OF HUERFANO RIVER PARCEL[1]
(includes all military use scenarios)

Designated Watershed Unit Name in Parcel[2]	Drainage Area (square miles)	Projected Sediment Yield[1] (tons/square mile/year)	Percent Local Increase Over Baseline Conditions	Projected Potential Impact in Watershed Area[3]
Local Area to St. Charles River (includes Edson Arroyo)	39.3	1,060	10	slight to moderate
Sixmile Creek	15.7	980	13	moderate
Fourmile Creek	15.1	1,220	12	moderate
Local Area to Huerfano River (western portion); excludes 4.7 square miles of Huerfano Canyon in southwest part of parcel	59.6	1,560	8	slight
Local Area to Huerfano River (eastern portion)	45.3	1,570	11	moderate
Local Area to Cucharas River	8.8	1,830	16	moderate
Doyle Arroyo	55.1	910	8	slight
North and South Chicosa Creeks	35.5	1,300	12	moderate
Hardesty Draw Drainage	0.4	1,000	12	moderate
Mustang Creek	63.2	1,420	8	slight

[1]Values are for assumed battalion training in given watershed area; the largest contiguous maneuver area suitable for battalion training contains about 34.4 square miles (Dames & Moore, 1977).

[2]Refer to Figure 3-6 for watershed locations.

[3]Impact evaluations do not include off-limits and restricted use areas, which would experience negligible impacts.

NOTE: Local area refers to contributing intervening drainage area between major watershed divides.

Based on U.S. Department of Agriculture, 1980:
- Very High Sediment Yield - 5100 tons per square mile per year
- High Sediment Yield - 1700-5100 tons per square mile per year
- Moderate Sediment Yield - 850-1700 tons per square mile per year
- Low Sediment Yield - 340-850 tons per square mile per year
- Very Low Sediment Yield - less than 340 tons per square mile per year

Conversion Factors:
- 1 square mile = 259,093 hectares (approximately)
- 1 ton/square mile/year = 2.8×10^{-6} m^3/hectare/year (approximately)

High salinity (i.e., high levels of dissolved salts) has been and remains a problem in regional surface waters. Within the Huerfano River Parcel, high concentrations of salts reportedly occur in both the Huerfano and St. Charles Rivers. These reportedly contribute significantly to the salt load in the Arkansas River (see Section 3.1.4 and Appendix E). The Apishapa River, which is outside the parcel but includes a portion of the on-site Mustang Creek drainage system, also contributes some salinity to the Arkansas River (Colorado Department of Local Affairs and Huerfano-Las Animas Council of Governments, 1979).

Salinity levels in surface waters in the Huerfano River Parcel are anticipated to locally increase due to increased sediment loading under reduced cover conditions (refer to Section 4.1.3 and Appendix C). However, salinity levels could vary considerably depending upon how extensively training occurs in the watersheds. Also, this would be dependent upon the total dissolved constituents in the surface waters, after carbonates have been converted to oxides, organics oxidized, and bromine and iodine converted to chloride. Salinity levels would therefore not vary directly as the estimated increases in potential sedimentation in the watersheds. Because of this fact, coupled with the ephemeral character of most streams and the lack of water quality data for them it would be difficult to assess impact levels. However, the proposed mitigation measures for runoff, erosion, and sediment control in the vicinity of alkaline soils in the parcel, as addressed in the LUMP, would provide some control of salinity at its source. Sedimentation ponds could be engineered and designed to limit TDS effluent limitations to Federal EPA standards, as proposed for coal mining operations.

The U.S. Army would monitor salinity levels in the surface waters in the Huerfano River Parcel in conjunction with sediment loading to determine if training activities were contributing to problems with surface water quality. Monitoring activities would also provide a basis to establish appropriate corrective measures in addition to those prescribed in the LUMP.

Dissolved Oxygen

Increased sediment loading in surface waters in the Huerfano River Parcel would also create turbidity problems (suspended inorganic and organic solids) as well as attendant rises in dissolved solids which in turn could deplete dissolved oxygen (DO) levels. This would occur primarily by the inhibition of photosynthetic activity (i.e., turbidity clouds preventing effective solar radiation) and from increased chemical and biological (anaerobic) activity requiring DO. Although this kind of impact is realistic, the magnitude of its effect attributable to the proposed military related activities is not anticipated to be measurable within the parcel.

Flow Variations

Overland flow characteristics of runoff would be affected by land use projects such as site clearing, road and building construction and construction of erosion control dams, diversion channels and sedimentation basins. These activities or structures would physically change local drainage patterns by either increasing or decreasing local runoff. Land clearing, vegetative destruction (i.e., from military training, construction activities, or range fires) and soil compaction could result in potentially increased surface runoff rates. This in turn could result in accelerated overland and channel erosion and associated sedimentation problems. However, temporary storage of runoff by structures such as small dams and excavations, could attenuate natural peak flows. The net effect is difficult to project at the present time. Should training occur, a monitoring program would be established to monitor and evaluate impacts, and if necessary, to determine and implement appropriate remedial measures, as necessary.

Oil Spills and Other Hazardous Toxic Substances

Under Executive Order 11507, dated February 5, 1970, all Federal agencies are required to have emergency plans and procedures for dealing with all types of water pollution incidents, regardless of where they occur. Army Regulation No. 200-1 (July 21, 1975) the current contingency plan for Fort Carson, includes procedures for water pollution control and response to spills of oil or other hazardous/toxic substances. Accordingly, all appropriate safeguards would be taken to protect the surface water resources from hazardous materials spillage in the Huerfano River Parcel, particularly in specific critical impact areas (i.e., near surface drainages). Water pollution from oil spills would be monitored and controlled according to this plan. Overall, accidental oil spills and toxic discharges would be very limited in occurrence and thus measurable impacts are not anticipated.

Surface Water Use

The provision for a potable water supply is an unresolved issue. An evaluation of water supply is discussed in Appendix E. Additionally, it is anticipated that access to the diversion headgates within the parcel could be permitted by the U.S. Army upon acquisition in order to meet the irrigation water demands outside the parcel (refer to Appendix E). These issues, however, would be resolved before purchase of the parcel. Also, after parcel acquisition, the water supply facilities within the parcel would be afforded adequate protection upon acquisition in order to maintain suitable water quality for irrigation use outside the parcel as discussed in the LUMP.

Sewage Treatment

Sewage treatment plant design, construction, and operation, including disposal of effluent and sludge and effluent monitoring would be in accordance with regulations established by the Colorado Water Quality Commission. Effluent could be pumped to a sewage lagoon and allowed to evaporate with a resultant zero discharge. Regardless of the ultimate disposal method, all structures would comply with applicable local, state, and Federal regulations, and thus no significant adverse impacts would be expected to occur.

Disposal of waste during field training would be accomplished by the same procedures used at Fort Carson. All organic wastes would be disposed of in temporary field latrines in accordance with specifications designed by the U.S. Army Environmental Hygiene Agency. No adverse impacts are anticipated, particularly considering the high evaporation rate, depth to underground water resources, and the relatively low intensity of proposed use. In areas of concentrated use, i.e., major recurring bivouac sites, portable chemical latrines would be provided.

Disposal of Solid Wastes

Construction materials and other solid waste materials would be salvaged for scrap to the extent practicable. Materials unsuitable for scrap would be accumulated and periodically removed to approved solid waste disposal facilities. Because of the nature of the proposed project, quantities of solid waste are expected to be very low and would have negligible impact on the surface water environment.

Practices for Controlling and/or Identifying Potential Adverse Impacts on Surface Water Quality

In addition to the practices for controlling and/or identifying potential adverse impacts to surface waters in the Huerfano River Parcel, a monitoring program would be established to collect surface water quantity and quality data at locations where streams exit the parcel boundary. This includes periods prior to and during construction of the cantonment site. These data, in conjunction with on-going operational data, would provide a basis for impact assessment and implementation of appropriate mitigation measures.

Ground Water Hydrology

A potable water supply source is presently undetermined. If the Huerfano River Parcel is selected and approved, further studies would be conducted to locate required supplies on site. If this effort was unsuccessful, it would be necessary to purchase off-site water rights. If this action was required, the relative impacts of the acquisition would be assessed.

Estimated water requirements for the cantonment area would vary from 110 gpm (7 l/s) for a battalion sized force to 441 gpm (28 l/s) for a brigade (125 gpd per capita (473 l/d)). Water requirements for troops away from the cantonment area during field maneuvers are estimated to be 20 gpm (1.3 l/s) and 81 gpm (5.1 l/s) for a battalion and brigade, respectively (23 gpd per capita (87 l/d)).

As described in Section 3.1.4, principal bedrock aquifers in the cantonment area are the Dakota Sandstone and the Cheyenne Sandstone. Data are limited for wells within 5 miles (8 km) of the planned cantonment area. Reported well yields within this area are low, with no recorded well producing more than 20 gpm (1.3 l/s). Water quality data for ground water in this area are also limited; however, according to records available from the State Engineer's Office most wells are suitable for stock watering. Appropriate treatment for human consumption would therefore be required.

If ground water were derived from the Dakota Sandstone and the Cheyenne Sandstone to meet the anticipated requirements, the low yields from existing wells indicate that a large number of wells spaced over several square miles would be necessary, although it is questionable whether the Dakota Sandstone and the Cheyenne Sandstone could meet the anticipated demands for the cantonment area. However, it is reasonable to expect that wells tapping the two aquifers could supply the anticipated demand during field maneuvers.

Considerable impacts would be expected from the withdrawal of ground water required in the cantonment area. The large number of low production wells would probably create a cone of depression covering a large area, resulting in a decline of ground water levels for neighboring wells tapping the same aquifer. Furthermore, a large scale decline in ground water levels could result in degradation of ground water quality due to a decrease in head and subsequent migration of poorer quality ground water into the aquifers.

An alternative would be to derive ground water for the cantonment area from shallow wells tapping the alluvial aquifer in the Huerfano River Valley. Within the parcel the alluvial aquifer has not been developed; however, downstream of the parcel the aquifer produces large quantities of ground water and could possibly be developed on-site to meet the needs of the cantonment area. Development of this source would appreciably reduce the amount of surface water available and could result in potential water rights problems.

4.1.5 Wildlife

Terrestrial Ecology

Impacts on terrestrial wildlife have been categorized into two groups:

1) Habitat degradation; and
2) Maneuver activity disturbance.

Habitat Degradation

Habitat degradation refers to damage to the environment and the subsequent effect on the wildlife community. A mechanized military training exercise by its very nature is incompatible with wildlife, thus certain adverse impacts are unavoidable. Since animal behaviour is so variable and difficult to predict, the extent of this kind of impact is nearly impossible to quantify. The assessment of impacts is greatly facilitated and substantiated by comparing parcel habitat types to the same habitats that occur at Fort Carson.

As described in Section 3.1.5, three habitat types are apparently more important to most species occurring in the parcel than are the other habitat types. These correspond to the Sandstone Breaks, Limestone Breaks, and Salt Meadow range sites, which comprise approximately 29 percent of the entire parcel and 23 percent of the area to be disturbed by military activities. These areas provide food, cover, and breeding habitat for many migrating birds and for a large proportion of the resident species such as Mule Deer, Coyote, Bobcat, Prairie Falcon and Golden Eagle.

It has been estimated that in a single year 25 percent to 75 percent of ground cover vegetation could be lost in portions of the important habitat areas. Observations on Fort Carson indicate that portions of these areas would receive severe impacts due to bivouac activities. Shrubs in these bivouac areas would be extremely impacted, removing a food and cover source for many species. Particularly affected would be Scaled Quail, Mule Deer, and songbird species which require shrubs. It is anticipated that the two to three year recovery periods specified in the LUMP would not provide sufficient time for shrub recovery for wildlife as food and cover.

Disturbed areas would be reseeded, and many annual forbs would initially invade the disturbed areas. Forbs provide spring and summer forage for Pronghorn, Mule Deer and other species. However, many species including Mule Deer and Pronghorn require shrubs during the winter. The annual forbs produced during the recovery period may increase available spring and summer forage over present levels, and as a result reproductive success and herd size may increase over the short term. However, the loss of winter forage in some areas will cause the animals to concentrate on undisturbed portions of the parcel and possibly on adjacent private lands during the winter. This could cause over-utilization of available winter forage on the parcel and a resultant loss in vigor and reproductive success, resulting in a long term decrease in herd size. A detailed assessment of winter forage availability to better quantify this potential for decreased annual productivity would allow for potential mitigation through mannagement. The assessment would consider Management Units, wildlife reserves, and areas which would probably be used repeatedly for maneuvers.

Scaled Quail habitat on the Huerfano River Parcel is primarily concentrated in management areas C, D, and E. Shrub damage in these areas would severely affect the quality of this habitat, particularly along the tops of draws and arroyos that are situated within the intensive use zones. Similar habitat situated in areas inaccessible to military vehicles, which includes numerous canyon and high relief areas, would be largely undisturbed and would probably increase in productivity. As a result, it is anticipated that relative abundance of Scaled Quail on the Huerfano River Parcel would be redistributed. Overall, it is estimated that Scaled Quail populations would realize a net loss.

Ground nesting birds such as Lark Bunting, Scaled Quail, and Mountain Plover would be directly impacted through the destruction of nests and eggs in areas where military maneuvers occur. Nest and egg destruction would increase under the Increased Use Scenario.

The disturbance and subsequent recovery efforts should lead to an increase in small mammal populations. This in turn would create a larger food supply for predators. Thus, the parcel may support higher populations of Coyotes, Swift Fox, and some raptors. An increase in the food supply may increase reproductive success due to improved vigor of the breeding populations, causing a movement of juvenile animals to adjacent private lands to establish new territories.

Inaccessible canyon areas, particularly the Huerfano River and Cucharas River Canyons with the prescribed 1/4 mile (0.4 kilometer) buffer zone would be expected to increase in habitat productivity. Accordingly, displaced species from training areas would, to some extent, migrate to these areas and occupy the available territories. Existing populations (e.g. Mule Deer and Bobcat, Mountain Lion and raptors) could increase, especially predator species that would have the added advantage of frequenting the impacted areas where small mammals are expected to increase.

As populations increase within the protected areas, offspring may seek other less concentrated areas, such as neighboring private land not used for military activities. Also, if individual populations grow too rapidly, it is possible that their numbers may fluctuate until an ecological balance is achieved. For example, if Mule Deer populations increase, an increase in Mountain Lion numbers would be expected, since Mule Deer are their preferred food. Increased Mule Deer use of the canyons could result in over-utilization of browse, and subsequent loss of vigor. Populations of Mule Deer and Mountain Lion would then decrease until food stuffs have again recovered. Thus fluctuations in numbers could result for a number of years.

Maneuver Activity Disturbance

It is recognized that military training activities are disruptive and in most instances incompatible with wildlife. However, unlike habitat degradation impacts, maneuver activity effects are relatively short term and immediate. An exception to this would occur if activities were conducted during the reproductive season and were to interfere with the production of viable offspring.

The most obvious effect of military excercise is the temporary displacement of surrounding animal populations. It is assumed that the degree of displacement is dependent on the type and intensity of disturbance. This kind of impact is manifested in two ways:

1) Tangible and visible disturbance within the immediate presence of the activity; and

2) Noise - Sound disturbances that carry far beyond the activity site. Although less direct, this impact could potentially be more significant, simply due to the larger area of impact.

Generalizations are extremely difficult to make as each species and individuals of the same species commonly react differently. However, because of the quiescent and secluded nature of the proposed impact area, the contrast of military related activities would probably be a very apparent and disconcerting intrusion for most animal species. Certain sensitive species such as the Mountain Lion and the Ferruginous Hawk could interpret the unpredictable disturbances as an intolerable threat and permanently abandon the area. Further, since many raptor species in addition to the Ferruginous Hawk are typically considered sensitive to even minor disturbances, training conducted during their pre-nesting and nesting periods could preclude viable offspring and therefore result in population declines.

In addition to the above, activities could result in the demise of less mobile animals, particularly populations nesting on ground sites. Shallow burrowers (e.g. voles, reptiles) could also be moderately impacted as vehicular ground pressure may crush burrows.

Although the proposed activity would result in a certain degree of unavoidable adverse impacts, evidence at Fort Carson documents that a surprisingly diverse population of wildlife has successfully adapted to various military oriented disturbances. This includes species considered especially sensitive such as Mountain Lion, Ferruginous Hawks and other raptors. Staff biologists have observed no apparent decline of any particular species. However, it is also important to note that scientific research data is unavailable to compare existing populations to previous populations. It is possible that the presence of sensitive species took some time to occur as they adapted to military activities.

Another important factor is the deferment period under each scenario which would not allow training during critical portions of the wildlife reproduction season. This deferment in conjunction with the rotational plan would significantly reduce the potential effects on wildlife, especially as compared to conditions occurring at Fort Carson.

Mitigation Procedures

1) To provide a sound basis for effective on-going wildlife management, the following studies before and after project implementation would be conducted:

   a) A four season aerial survey to inventory big game and their preferred habitat;

   b) Mammalian predator and raptor inventory including nest sites and preferred habitat identification;

   c) A nesting season bird census of each habitat type including ecotones by transect or plot procedures;

   d) Small mammal census by capture mark recapture techniques;

   e) Reptile and amphibian census using drift fences and pitfall traps where appropriate;

   f) U.S. Fish and Wildlife Service Habitat Evaluation Procedures (HEP), if appropriate, would be used to evaluate certain habitat on the parcel;

   g) Location of all unique or sensitive habitats such as wetlands and riparian areas would be noted;

   h) After project implementation an ongoing wildlife monitoring program would be initiated. Control study plots would be established in undisturbed areas for purposes of comparison analysis; and

   i) During both baseline data gathering and monitoring field work particular attention would be given to side canyons off the Huerfano and Cucharas Rivers and to the canyons on Unit E since these areas are considered to be potentially significant habitat. These include but are not limited to Karrick Canyon, Sheep Canyon, Thief Canyon, Little Joe Canyon and Poleline Canyon.

2) The protected wildlife areas would be managed for naturally occurring species and existing habitat would be enhanced when possible. The canyons along the Huerfano and Cucharas Rivers would be fenced (designed to allow wildlife passage) along a quarter mile buffer zone and managed primarily for Mule Deer and raptors. The upland area between the two rivers would be managed for Pronghorn. Limestone and sandstone ridges would be managed for Scaled Quail. The wildlife area along the east edge of Management Unit B would be managed for Pronghorn and Scaled Quail. Additionally, where appropriate conditions exist, deciduous trees such as cottonwoods, willows and Russian Olive would be planted along the Cucharas and Huerfano Rivers.

3) To prevent buildups of species in the wildlife protection areas, a cooperative agreement with the Colorado Division of Wildlife would be instituted to program a controlled harvest. Game populations would be closely monitored. Hunter management would be similar to that presently existing on Fort Carson. When populations appear to be near or over carrying capacity, hunters would be encouraged to hunt in these areas. If populations and/or forage become severely depressed, the number of hunters entering the wildlife areas would be appropriately controlled.

   Regulated trapping of furbearers would also be conducted to prevent overharvest and to help control populations. If fur prices become so low that there is not enough monetary incentive to effectively control predator populations, a predator control program would be instituted.

4) Areas containing sensitive species would be identified during the wildlife inventory to establish appropriate avoidance procedures. As an example, side canyons found to provide wildlife water supply during July and August would be considered for designation as off-limits.

5) If the Huerfano River Parcel is selected, any endangered species found during the wildlife inventory and/or viable habitat will be noted, and communicated to the U.S. Fish & Wildlife Service pursuant to Section 7 of the Endangered Species Act (16 USC 1536). Coordination procedures as prescribed by the Endangered Species Act have already been initiated with the U.S. Fish and Wildlife Service; as a result a raptor survey conducted in concert with the Service was completed in early April 1980. Results of the survey are presented in Appendix F.

   Golden Eagle eyries located in the Huerfano River Canyon will be protected from disturbance during the breeding season. Critical areas of Golden Eagle habitat will also be determined and protected as necessary. In accordance with the Bald Eagle Protection Act (50 CFR 22), the U.S. Fish and Wildlife Service will be consulted regarding all appropriate protection procedures.

6) Existing windmills would be maintained, and erosion control structures also managed to supply scattered water sources. Some erosion control structures would be designed to include a deep pool lined with bentonite to provide water for most of the year. Additionally, wildlife guzzlers would be constructed in suitable locations.

7) Enhancement efforts would include, but not be limited to food plots at proper locations, construction of brush piles to supply cover in areas not being used for vehicular activity, planting

of shrubs to supply food and cover in appropriate locations, and inclusion of valuable forage species in reclamation seed mixtures. Other suitable enhancement measures may be recommended after completion of the intensive wildlife inventory.

4.1.6 Meteorology and Air Quality

General

The most sensitive air quality issue at the local and regional level is the potential impact of the proposed military training on ambient particulate standards. Background concentrations in the entire region are already high, about 30 $\mu g/m^3$ (Colorado Department of Health, August 1974), in relation to the Colorado standard of 45 $\mu g/m^3$. In order to satisfy training needs, vehicle travel on maneuvers during a brigade-size exercise would occur on gravel roads and overland. Because of the soil types that exist in the area, particulate emissions from vehicle movement would be significant. In addition to the emissions from vehicle movement, wind erosion emissions would be significant.

The criteria pollutants that would be emitted from the proposed activities are particulate matter, carbon monoxide, sulfur dioxide, and nitrogen oxides. Each pollutant will be discussed separately in three sub-sections:

1) Criteria used to estimate emissions and the results;

2) Results of dispersion modeling and comparison to existing levels and standards; and

3) Impact and mitigation.

Particulate Matter

Criteria Used to Estimate Emissions and the Results

The primary sources of particulate emissions are vehicle movement and wind erosion from severely impacted land. The first of these sources is obvious. As a vehicle travels on a dirt road, turbulence caused by the vehicle movement and other processes causes road matter to become suspended as airborne dust. The amount of dust emitted by a vehicle as it travels over the road is a function of the silt content of the road surface, speed and weight of the vehicle, and the number of days of the year the road surface is dry.

The other primary source of particulates is wind erosion. Wind erosion already exists on the Huerfano River Parcel as it does in most of eastern Colorado. While the magnitude of this baseline erosion is not known, the amount eroded is reflected in the present background ambient concentration of particulates. By definition, the background concentration is that concentration resulting from natural sources such as wind erosion, forest fires, and volcanoes. Therefore, the background concentration levels in the region of the Huerfano River Parcel are an indication of the present levels of wind erosion from the parcel. In order to assess how much additional wind erosion would result from the Army's training activities, and therefore the impact on the existing ambient concentrations, an estimate was made of the acreage that would be severely impacted.

Details of the particulate emissions inventory from vehicle movement are presented in Appendix G. Briefly, the vehicle emissions inventory included calculating the amount which would be emitted from each different type of vehicle used during training, multiplying by the number of miles each vehicle would travel on and off road, and then multiplying by the number of vehicles of that type used during training. Other sources of particulates from training activities would be space heaters, vehicle tail pipe emissions, and aircraft tail pipe emissions. The methods used to calculate these emissions are also presented in Appendix G.

If the worst-case LUMP scenario, Increased Use, is assumed, the Land Management Units could support as a minimum 4.1 brigade-size training periods per year on units ABC and a maximum of 4.8 brigade-size training periods on units CDE. Therefore, worst-case particulate emissions would occur when training on management units CDE. Table 4-7 presents a summary of the particulate emissions inventory by source for this worst-case configuration.

TABLE 4-7

WORST-CASE PARTICULATE EMISSIONS INVENTORY
INCREASED USE SCENARIO, MANAGEMENT UNITS CDE
HUERFANO RIVER PARCEL

Source	Particulate Emissions, Tons Per Year (TPY)
Wheeled vehicle movement[a]	7498.6
Tracked vehicle movement[b]	2911.2
Wind erosion	2564.0
Tail pipe, gasoline vehicles	0.9
Tail pipe, diesel vehicles	2.8
Space heating	14.6
Aircraft	1.4
TOTAL	12,993.5

[a]Based on 73.3 percent of the total brigade-size vehicle fleet being in training area.

[b]Based on 84.7 percent of the total brigade-size vehicle fleet being in training area.

Results of Dispersion Modeling and Comparison to Existing Levels and Standards

After a complete emissions inventory was obtained, dispersion modeling was used to estimate the resultant ambient concentrations. Two different standards must be addressed: the 24-hour and the annual geometric mean. The current Colorado 24-hour and annual standards are 150 $\mu g/m^3$ and 45 $\mu g/m^3$, respectively. The Climatic Dispersion Model, CDMQC, was used to model the annual standard, and the Turner (1969) method for modeling area sources was used for the 24-hour standard. In addition to these models, a 24-hour worst case concentration was modeled using the Turner line source model (1969). The line source model was used to estimate concentrations arising from a road surface, because the highest 24-hour concentrations were expected at short distances from heavily used roads.

The impact on the annual standard was estimated by the CDMQC air quality dispersion model. Because of the configuration of the Huerfano River Parcel, two different scenarios were analyzed. The first of these analyses assumed training would occur on the largest three Land Management Units, CDE. This would result in the largest annual emissions. However, Management Units ABC are very close to the city of Pueblo, which is currently nonattainment for particulates, and could impact Pueblo's air quality more than CDE training units, even though the emissions from CDE would be higher.

Annual emissions were distributed in the Huerfano River Parcel according to the source of the emission. Vehicle movement and tail pipe emissions were distributed evenly in the three land management units in question, either ABC or CDE. Wind erosion emissions and aircraft emissions were distributed uniformly throughout the entire parcel; whereas emissions from the cantonment area were confined to being emitted from that location. Details of the modeling are presented in Appendix G.

Figures 4-1 and 4-2 present the annual particulate concentrations, as estimated by the CDMQC model, for training areas ABC and CDE, respectively. A 30 $\mu g/m^3$ concentration was added to reflect the background concentrations present in the area (Air Pollution Control Division, August 1979) for receptors outside the city limits of Pueblo. Around the city of Pueblo, the concentrations presented in the figures are the incremental concentrations produced by the proposed training area and do not include a baseline or background concentration.

When training occurs on land management units ABC, it is estimated, that concentrations along the borders of the parcel would range from a low of 32.1 $\mu g/m^3$ to a high of 40.5 $\mu g/m^3$, as seen in Figure 4-1. The Colorado annual particulate standard is 45 $\mu g/m^3$. Inside the parcel, the maximum concentration predicted by the model is 48.7 $\mu g/m^3$. The downtown Pueblo particulate increment was 1.5 $\mu g/m^3$.

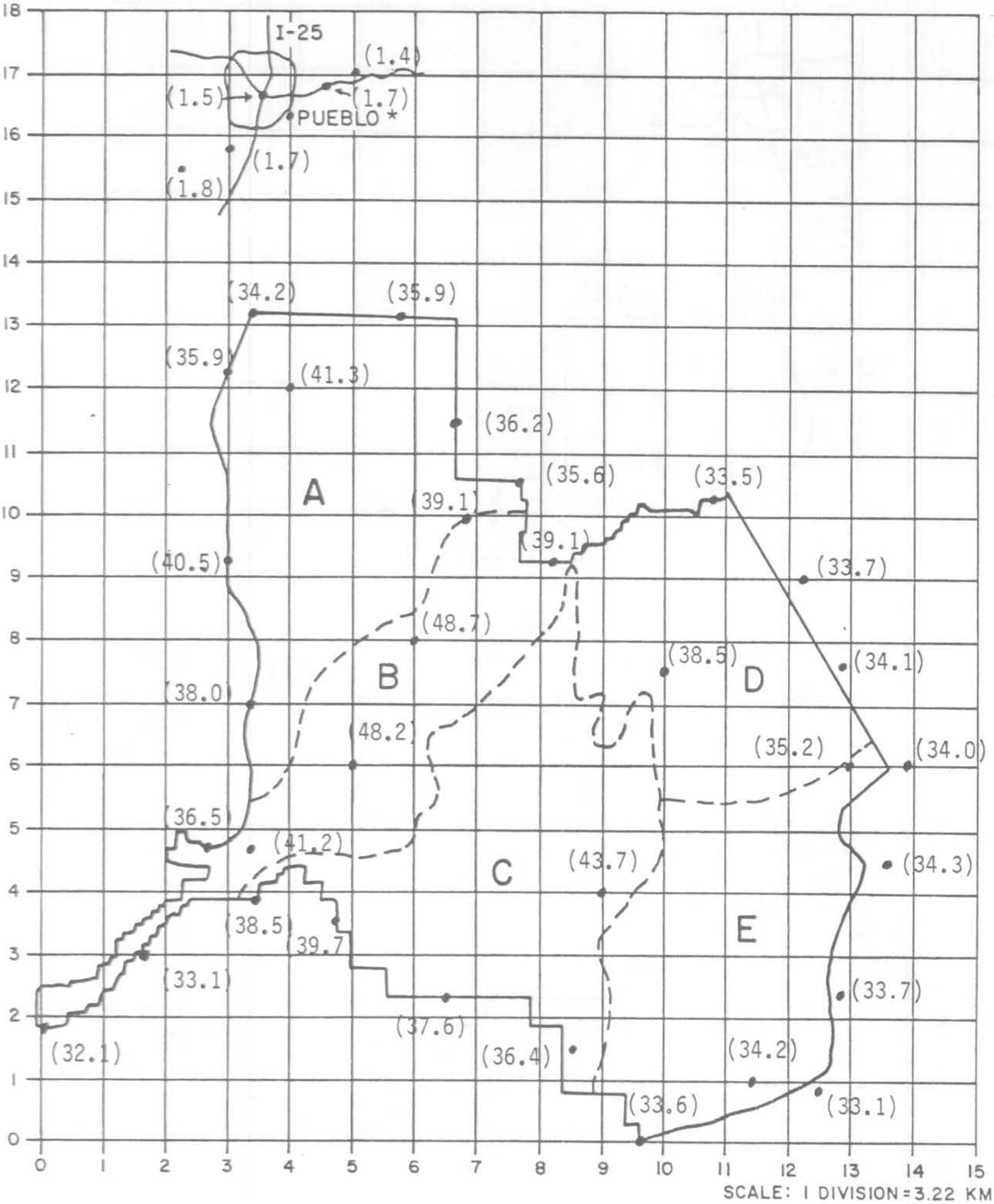


FIGURE 4-1

HUERFANO RIVER PARCEL

WORST-CASE ANNUAL CONCENTRATIONS IN μg/m³
FOR TRAINING AREA ABC

*No baseline added for Pueblo area receptors

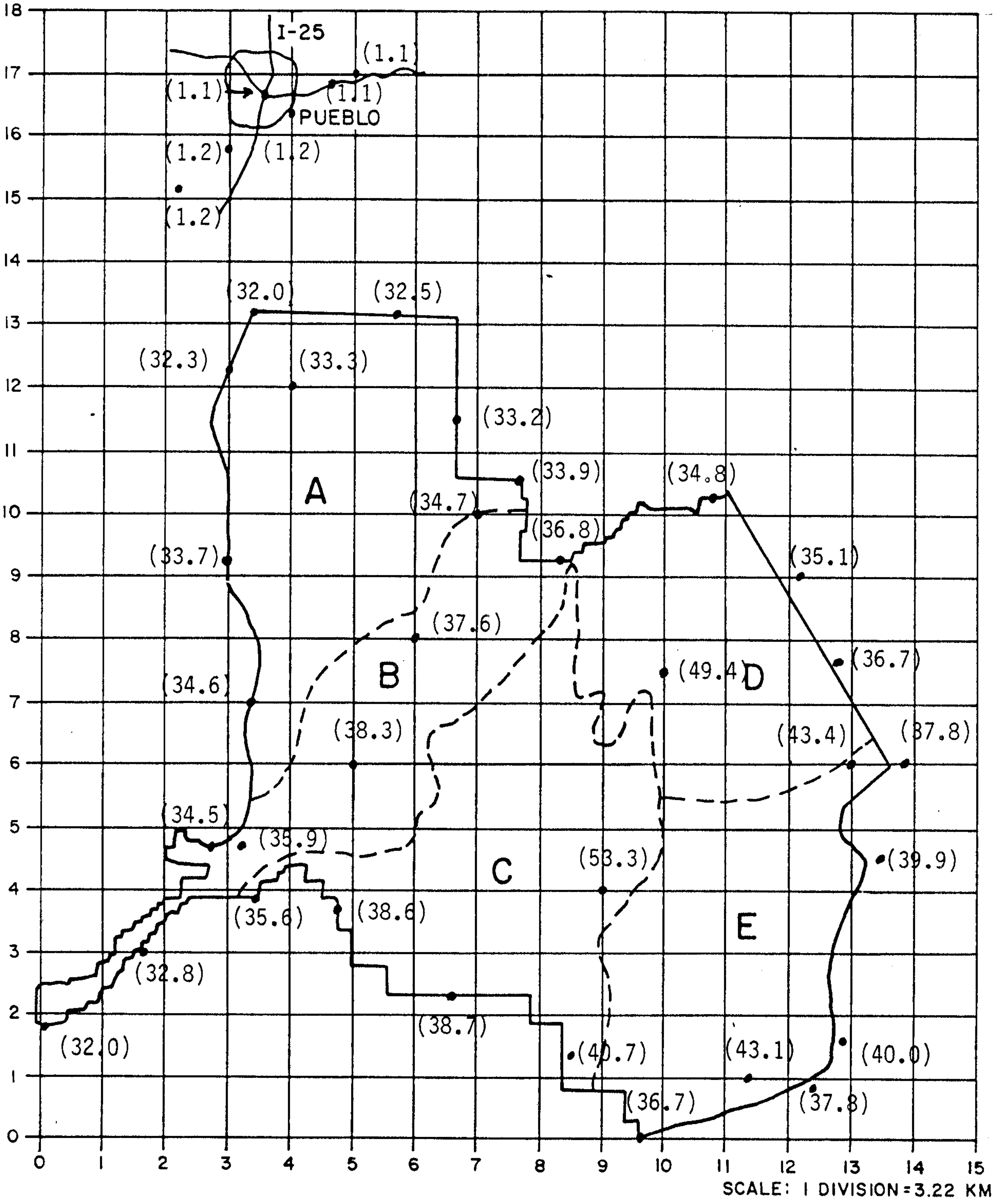


FIGURE 4-2

HUERFANO RIVER PARCEL

WORST-CASE ANNUAL CONCENTRATIONS IN μg/m³
FOR TRAINING AREA CDE

*No baseline added for Pueblo area receptors

The EPA has established incremental concentration levels for which the impact of a source which would become insignificant (Federal Register, June 19, 1978, p. 26398). These concentrations are reproduced in Table 4-8. When concentrations from a source as predicted by an air quality model reach the levels defined in Table 4-9, the source is considered to have insignificant impact downwind of that point. The concentrations predicted in Pueblo by the model are slightly above the level of insignificance.

TABLE 4-8

LEVEL OF INSIGNIFICANCE FOR VARIOUS AVERAGING TIMES ($\mu g/m^3$)

	1-Hour	3-Hour	8-Hour	24-Hour	Annual
Particulate Matter	--	--	--	5	1
Sulfur Dioxide	--	25	--	5	1
Carbon Dioxide	2000	--	500	--	--
Nitrogen Dioxide	--	--	--	--	1

The results of the CDE training units, Figure 4-2, show border concentrations ranging from 32.0 $\mu g/m^3$ to 40.0 $\mu g/m^3$; internal receptor concentrations ranging from 33.3 $\mu g/m^3$ to 53.3 $\mu g/m^3$. The Pueblo area receptor concentrations are 1.1 and 1.2 $\mu g/m^3$. Again, this is just slightly above the level of insignificance.

The impact on the 24-hour standard by the proposed training facility was estimated using two different models. The first model was the Turner area source model and the other was the Turner line source model. Appendix G presents the details of the calculations used in the models.

The results of the area source modeling for the 24-hour standard indicated a worst-case impact in Pueblo of 2.9 $\mu g/m^3$, assuming training would occur in units ABC. At receptors just outside the borders, the 24-hour worst-case concentration was 3.7 $\mu g/m^3$. Both concentrations are below the 5 $\mu g/m^3$ level of insignificance as defined by the EPA for a 24-hour average (Table 4-8).

The results of the line source calculations indicate that, in the worst-case scenario, the Colorado 24-hour particulate standard will be violated within 500 meters of the road surface. The worst-case scenario would occur when all 19 companies move into the field within a 24-hour period passing over the same section of road. Details of the calculations are presented in Appendix G.

Impacts and Mitigation

The initial assessment of the particulate emissions indicated that high emissions would occur; therefore some mitigation measures have already been incorporated into the preceding analysis. All main trails, as defined in the glossary, would be graveled to reduce particulate emissions. Mitigation measures would be incorporated to reduce wind erosion of soils (see Section 4.1.2).

Increases in particulate concentrations, assuming the worst-case CDE training unit, would be slight to moderate along the borders of the parcel. No violations of the annual standard are predicted outside the parcel in areas having baseline concentrations of 30 to 35 $\mu g/m^3$. Impact on Pueblo would be slight with an estimated increase of 1.2 $\mu g/m^3$ added to existing concentrations. Worst-case line source calculations indicate that violations of the 24-hour standard would occur within 500 meters of the road surface. In order to mitigate this impact, either roads expected to carry that amount of traffic would be paved or road construction within 500 meters of a property border would not be allowed.

Although the results of the modeling indicate a 1.5 $\mu g/m^3$ incremental concentration in Pueblo, it is believed that this is a conservative estimate and would probably be lower. A major factor in the conservative estimate is that particulates transported over medium to long distances undergo settling and deposition. As a plume travels downwind, the plume disperses in the horizontal and vertical directions. When the plume comes in contact with the ground, the particulates are deposited onto the ground, other objects, and plants. This process removes particulate matter from the plume and results in lower ambient concentrations downwind. The air quality dispersion model CDMQC does not take this factor into account, and therefore overestimates concentrations at receptors a relatively long distance away.

The other factor determining the conservative estimate is that the wind erosion contribution in Pueblo is overestimated by the modeling procedure. On bare ground wind erosion does not occur until wind speeds have reached a speed of 12 to 13 mph (19 to 21 kph) at the ground or a short distance above it. The joint frequency distribution for Pueblo indicates that south to southeasterly winds in excess of 12 mph (19 kph) do not occur as often as the regular joint frequency distribution would indicate. As a result of that, the CDMQC dispersion model transports the wind erosion section of the emissions northwest toward Pueblo even when the wind speeds are less than 12 mph (19 kph), when wind erosion would not be occurring. As a result of this process, receptor concentrations northwest of the parcel are overestimated, while east and southeast of the parcel, receptor concentrations are underestimated.

As a result of these two factors it is believed that the actual impact in Pueblo would be below the level of insignificance, and that mitigation measures beyond those already incorporated would not be required. If additional mitigation would be required in the future, effective techniques would include speed reduction during convoying, establishing wider buffer areas, and reducing vehicle-miles traveled per year. If this parcel is acquired, training would not begin for two or three years. During the interim, a monitoring program would be conducted to collect particulate matter baseline concentrations and on-site meteorological data.

In addition to baseline monitoring, the monitoring network would be used to assess ongoing training impacts. If, as a result of training activities, short-term or long-term violations were measured, training could be adjusted or buffer areas established to minimize future occurrences.

The monitoring network would consist of four high volume samplers and a meteorological station. The high volume samplers would be located basically north, east, south and west of the parcel in locations with easy access and where 110 volt AC line power could be readily supplied. The meteorological station would probably be located relatively close to the cantonment area so that regular site visits could be easily made and 110 volt AC power would be available.

Training would not be expected to occur until 1983 or 1984, thus, present ambient particulate concentrations are expected to continue with no net degradation. According to the Colorado Department of Health Report to the Public, 1979, the Pueblo area is expected to continue as a nonattainment area with respect to particulates. Baseline concentrations in rural areas are also expected to remain the same.

With the current deliberations concerning the present particulate standard, a new respirable particulate standard could possibly be established. If this occurs, the monitoring network could be modified to sample for the respirable size particulates, and baseline data could be collected to estimate the possible impacts. It is expected that if the new standard is adopted, impacts from the parcel would be less than those which have been projected.

Carbon Monoxide

Criteria Used to Estimate Emissions and Results

The primary source of carbon monoxide would be tail pipe emissions from gasoline-powered vehicles. Secondary sources emitting carbon monoxide would be diesel-powered vehicles, space heating for the buildings in the cantonment area, and aircraft. Carbon monoxide emissions are caused by incomplete burning of fossil fuels. Gasoline engines emit more carbon monoxide per mile than diesel engines, because gasoline engines have a lower temperature of combustion. In addition, carbon monoxide emissions increase as the speed of the vehicle decreases.

A carbon monoxide emissions inventory was prepared for the CDE Management Units. Details of the inventory calculations are presented in Appendix G. Basically, the method involved computing the total number of miles traveled by diesel- and gasoline-powered vehicles in a year, the number of aircraft hours; and the heating requirements for the buildings in the cantonment area. After figures were computed, emission factors were used to compute the total annual emissions. Table 4-9 summarizes the results of the worst-case emissions inventory for the Increased Use Scenario on Management Units CDE.

TABLE 4-9

WORST-CASE CARBON MONOXIDE EMISSIONS
INCREASED USE SCENARIO, MANAGEMENT UNITS CDE
HUERFANO RIVER PARCEL

Source	Emissions, Tons Per Year (TPY)
Gasoline-powered vehicles	448.8
Diesel-powered vehicles	65.4
Space heating	65.7
Aircraft	31.8
TOTAL	611.7

Results of Dispersion Modeling and Comparison to Existing Levels and Standards

After the complete emission inventory was obtained, dispersion modeling was performed to estimate the ambient air quality impact. Worst-case 1-hour and 8-hour average CO concentrations were modeled using the Turner (1969) line source model. Details of the calculations are presented in Appendix G. The results of the calculations indicate the worst-case 1-hour concentration 100 meters from the road to be 106 $\mu g/m^3$. The 1-hour Colorado standard is 40,000 $\mu g/m^3$. Likewise, the worst-case 8-hour concentration would be the same as the 1-hour since the intensity would not change. The 8-hour Colorado standard for CO is 10,000 $\mu g/m^3$. Since there are no major sources of carbon monoxide close to the Huerfano River Parcel, baseline concentrations are estimated to be around 1.0 ppm, about 1100 $\mu g/m^3$.

Impacts and Mitigation

No mitigation measures are considered since the impact on the Colorado air quality standards would be negligible.

Sulfur Dioxide

Criteria Used to Estimate Emissions and Results

The primary source of sulfur dioxide emissions would be space heaters. It is assumed, as worst-case, that coal would be used for space heating. It is likely however, that natural gas would be the preferred fuel and would produce lower sulfur dioxide emissions. Other sources of sulfur dioxide emissions would be vehicle and aircraft tail pipe emissions.

Sulfur dioxide emissions depend primarily on the sulfur content of the coal or fuel being burned and the type of control equipment installed. Details of the emission inventory calculations are presented in Appendix G. It was assumed that space heating would be provided by small, hand-fired coal burning stoves. While this is probably not the case, it is a worst-case assumption. In addition, it was assumed that the coal would contain 1.0 percent sulfur or 1.2 pounds of sulfur per million Btu. A summary of the emisssion inventory is presented in Table 4-10.

TABLE 4-10

WORST-CASE SULFUR DIOXIDE EMISSIONS
INCREASED USE SCENARIO, MANAGEMENT UNITS CDE
HUERFANO RIVER PARCEL

Source		Emissions, Tons Per Year (TPY)
Space heating		27.7
Diesel-powered vehicles		6.0
Gasoline-powered vehicles		0.4
Aircraft		1.0
	TOTAL	35.1

Results of Dispersion Modeling and Comparison to Existing Levels and Standards

After the emission inventory was obtained, dispersion calculations were performed to estimate the impact on the 3-hour average ambient concentration. The Colorado 3-hour average sulfur dioxide standard is 700 $\mu g/m^3$. Worst-case conditions were assumed to be heating all living spaces and an outside temperature of -10°F (-23°C). Details of the calculations are presented in Appendix G. The calculations estimate a worst-case 3-hour concentration of 35 $\mu g/m^3$ adjacent to the cantonment area where space heating would occur. There are no major sources in the vicinity of the Huerfano River Parcel, so existing baseline concentrations should be small.

Impacts and Mitigation

No mitigation measures are considered because the impact on the ambient air quality would be negligible.

Nitrogen Oxides

Criteria Used to Estimate Emissions and Results

The primary source of nitrogen oxide emission is diesel-powered vehicles. Secondary sources are gasoline-powered vehicles, space heaters, and aircraft. Nitrogen oxides are emitted as a result of high temperature combustion. Diesel vehicles emit more nitrogen oxides per mile traveled than do gasoline powered vehicles. As the vehicle speed is reduced, nitrogen oxide emissions are reduced.

Details of the emission inventory are presented in Appendix G. The emissions inventory was compiled in the same way as for carbon monoxide, except different emission factors were used. It was assumed training would occur on Units CDE. Table 4-11 presents a summary of the emission inventory for nitrogen oxides.

TABLE 4-11

WORST-CASE NITROGEN OXIDES EMISSIONS
INCREASED USE SCENARIO, MANAGEMENT UNITS CDE
HUERFANO RIVER PARCEL

Source	Emissions, Tons Per Year (TPY)
Diesel-powered vehicles	47.6
Gasoline-powered vehicles	9.3
Aircraft	3.2
Space heaters	2.2
TOTAL	62.3

Results of Dispersion Modeling and Comparison to Existing Levels and Standards

Due to the lower concentration of emissions and the distribution of the emissions, no dispersion modeling was done. The only existing reference is a Federal guideline for the annual average of 100 $\mu g/m^3$. No baseline data are available in the area but no major sources are close, so baseline concentrations should be close to zero.

Impacts and Mitigation

No mitigation measures are necessary because the impact on the air quality will be negligible.

4.1.7 Sound

The principal sources of noise arising from training exercises at the Huerfano River Parcel would be troop maneuvers, simulation of artillery and tank fire, helicopters and aircraft. In addition, the convoy of wheeled vehicles to and from Fort Carson would create noise along Interstate Highway 25 and county roads providing access to the parcel. The following discussion of noise sources and impacts relates to the basic on-site training activities. The noise from these activities is not particularly sensitive to the absolute number of men, vehicles, and equipment used if these training exercises are of about battalion size. The noise impact from off-site convoys is sensitive to size and is discussed separately.

The noise attributable to wheeled and tracked vehicles on the parcel has been conservatively estimated at a day-night sound level of L_{dn}=50.7 dB at 1/2 mile (0.8 kilometers) from the center of vehicle activity for an intensive maneuver. The sound level contribution for a similarly intensive exercise involving six helicopters in operation at all times is a day-night sound level of L_{dn}=55.9 dB measured at 1/2 mile (0.8 kilometers). For simulated artillery fire, the contribution is L_{dn} = 77.3 dB at 1/2 mile (0.8 kilometers). For the maximum planned level of jet aircraft support, the day-night sound level contribution would be L_{dn}=69.7 dB 1/2 mile (0.8 kilometers) from the center of activity. This level of jet activity would occur only five times per year but does not include the effect of direct overflights by aircraft over populated areas. In cases where overflight at low altitude (1,000 feet) (305 meters) is unavoidable, the L_{dn} contribution could be as high as L_{dn}=71 dB. These estimates are conservative; higher sound levels are predicted than may actually be expected because only attenuation of sound by geometrical spreading has been considered.

The sound levels measured at the site boundary and beyond are highly dependent on the location of activity on the parcel. As a result of the LUMP scenarios the perimeter of the parcel would experience a cyclical variation in ambient sound levels dependent on parcel utilization. For example, an armored column moving 1,000 feet (305 meters) from the north boundary would result in a steady sound level at the boundary of 76.5 dB, but it would not be audible at the southern boundary approximately 20 miles (32 kilometers) away.

Table 4-12 shows the background ambient sound levels at the Huerfano River Parcel measurement locations (see Figure 3-13) and the ambient sound level changes attributable to the proposed activities. Location 3 is at the parcel boundary and Location 4 is on the parcel. In all cases, the training activities are assumed to occur 1/2 mile (0.8 kilometers) inside the parcel boundary nearest to the measurement location. For a particular exercise only one location would experience the sound level increase indicated in Table 4-12. Since potentially noise sensitive locations were selected for the measurement program the impacts indicated below would be less severe if the training activity is remote from all of the measurement locations.

The Environmental Protection Agency (EPA) has determined that sound levels below L_{dn}=55 dB do not degrade public health and welfare. At the northern boundary, existing background ambient sound levels range from L_{dn}=39 dB to 53 dB. For the lower background ambient sound level, during maneuvers homes approximately 1 mile (1.6 kilometers) from the boundary may experience an increase of approximately 6 dB attributable to vehicle maneuvers taking place 1/2 mile (0.8 kilometers) inside the parcel. A day-night sound level of 45 dB would be expected. This exposure is below the EPA goal of L_{dn}=55 dB. At the higher background ambient sound level (L_{dn}=53 dB) no increase in sound level would

TABLE 4-12

BACKGROUND AMBIENT, COMBINED TRAINING ACTIVITY AMBIENT AND CHANGE IN AMBIENT SOUND LEVEL AT MEASUREMENT LOCATIONS, HUERFANO RIVER PARCEL

Location	Background Ambient Sound Level L_{dn}, dB	Combined Training Activity and Background Ambient Sound Level, L_{dn}, dB	Change, dB
1	50.4	51.4	+ 1.0
2	53.3	54.3	+ 1.0
3	45.0	73.6	+28.6
4[a]	38.7	-	--
5	47.0	50.9	+ 3.9

[a]Location 4 is within the parcel, and sound levels were therefore not addressed.

result. Helicopter activity at the maneuver site would emit noise below the EPA criterion. The maximum sound level expected for simulated artillery is L_{dn}=62 dB at locations approximately 1 mile (1.6 kilometers) from the parcel boundary. This level is 7 dB above the EPA criterion and could result in an ambient sound level increase of 23 dB. This would constitute a severe impact in a populated area if the activity were ongoing; however, this level of blast simulation occurs sporadically and may be acceptable. This impact would be somewhat mitigated by keeping training activities which produce the most noise as far from populated areas as permitted by the LUMP scenarios.

One mile (1.6 kilometers) from the parcel boundary the contribution of jet aircraft maneuvers on the parcel to the ambient sound level would be L_{dn}=60 dB, not including the noise of approach and departure from the parcel. Jets flying as low as 1000 feet (305 meters) above ground level may cause peak sound levels of 93.5 dB along their flight path within 5 to 9 miles (8 to 14.5 kilometers) of the site boundary, and repeated overflights could increase the day-night sound level to L_{dn}=71 dB. This level exceeds the EPA criterion by 16 dB and would constitute an extreme impact at a few residences for a few days of the year. Jet aircraft in transit from Buckley Air Force Base, Denver, would cause a negligible impact along the flight path. Mitigation of sound levels caused by helicopters and jet aircraft includes all aircraft flying as high as practical when proceeding to and from the parcels. Flight paths should be selected to minimize travel over populated or noise-sensitive areas.

The EPA criterion was discussed above for vehicle maneuvers, simulated artillery, helicopters and aircraft. Criteria for the Department of Housing and Urban Development are shown below:

Acceptability	L_{dn} (dB)
Normally acceptable	less than 65 dB
Normally unacceptable	greater than 65 dB
Unacceptable	greater than 75 dB

Noise emitted by the individual activities and the combined activities on the parcel would meet the "normally acceptable" criterion at distances of greater than 1 mile (1.6 kilometers) from the boundary. As with the EPA criteria, the activities on the parcel would affect only a small portion of the perimeter of the parcel. Locations distant from the center of activity would receive negligible impact.

The Colorado noise regulation limits noise during daytime to below an A-weighted sound level of 55 dB measured at 25 feet (191 meters) inside the property line. This is the maximum permissible noise level for residential (family housing) land uses. Since the criterion limits maximum sound levels and is not a time average criterion (as is L_{dn}), the noise from maneuvers using helicopters, jet aircraft and simulated artillery fire would be non-compliant up to a distance of several miles. Maximum noise levels allowed for other land uses such as commercial and industrial are sealed to a maximum of 80 dB, allowing these land uses closer to the parcel. The Colorado noise regulation is considerably more severe than the Federal regulations, however, it does not specifically limit noise from such activities as training maneuvers and is not intended to assess the noise from aircraft. Mitigating measures could include scheduling training activities which produce the most noise as far from populated areas as permitted by the LUMP scenarios.

Wheeled vehicles would be transported to the site in convoys of as many as 826 vehicles for brigade training periods. Vehicles would be travelling at 40 miles per hour (64 kph) with a spacing of 492 feet (150 meters). The sound level characteristics of the group are as follows:

Vehicle Type	Percentage	A-Weighted Sound Level, dB, at 164 ft (50 m)
Heavy Wheel Vehicles (2.5 tons or greater)	49	89.9
Light Wheel Vehicles (less than 2.5 tons)	51	58.0

For the distribution of vehicles shown a day sound level of L_d = 76 dB at 164 feet (50 meters) would result if the convoy takes place during the day (0700-2200), or a night sound level of L_n=77 dB if at night (2200-0700). A sound level of about 90 dB lasting several seconds would occur during the passage of each heavy wheeled vehicle.

The impact would be moderate where highway traffic already creates comparable day or nighttime sound levels. In areas where little nighttime traffic occurs the impact on individual nights may be severe at residences up to about 1/2 mile (0.8 kilometers) from the highway.

The magnitude of noise impact from these convoys is affected by both the noise exposure (increase in daily L_{dn}) and the number of times the convoys take place. Since each convoy's sound levels (L_{eq}) remain fairly constant, it is evident that the fewer training exercises per year, the lower the expected off-site impacts.

The transportation of tracked vehicles from Fort Carson to the site would be accomplished by rail, utilizing existing commercial tracks. Two trains of 85 cars each are required to transport the 432 tracked vehicles of a brigade size exercise. Traffic on the north-south trunk line currently consists of between 12 and 16 unit coal trains per day each having about 6 engines and 100 coal cars. Increased traffic of 24 unit trains per day is predicted for the near future. Thus, two trains required for tracked vehicles would not increase the traffic density sufficiently to cause an increase in sound levels in communities adjacent to the tracks.

4.1.8 Socioeconomics, Land Use and Transportation

General

There is a need for a well trained army in case of international crisis. A major strength of any country or political system rests with the ability to defend its people in case of attack. While it is not possible to place a value on individual lives or to quantify the dollar value of adequate national defense, it can be inferred that practice training improves the ability and performance of troops in actual combat roles. For this reason acquisition of supplemental training land would be advantageous for national defense purposes in terms of added military preparedness and potentially larger numbers of lives saved.

The primary impacts in the category of socioeconomics are related to the people who presently live in the area of the parcel, the people who would come to the area as a result of the acquisition of the land, and any changes in the economy resulting from changes in business type and volume or alteration of tax revenues for the area. Changes in lifestyle and dislocation of individuals and families are among the non-quantifiable impacts included in this category.

Population Impacts

Population changes for this site include the displacement of an estimated 35 people, including families and single individuals, all of whom live in the Pueblo County portion of the Huerfano River Parcel (Personal communication, Harry A. Allen, Supt. District 70 Schools, February 8, 1980). About seven of these are children and the rest are adults assumed to be employed in ranching. Under the Uniform Relocation Assistance and Real Property Acquisition Act of 1970 (PL 91-646) the U.S. Army, as the responsible government agency, must find suitable similar housing of the same or better quality, as well as providing financial moving and relocation assistance, if these people are displaced from the parcel. The positive side of this issue is that fewer people would be displaced here than at many other potential sites.

Operation and maintenance of the Huerfano River Parcel would require about 35 people to be located within commuting distance of the parcel; 13 would be civilians and 22 would be military personnel. None of these workers would live at the site, and they could choose to live anywhere nearby. Pueblo or possibly Rye or Colorado City might be potential locations. The lifestyle and economic behavior of these invididuals in most cases would be more urban-oriented than is the lifestyle of those individuals who now live on the parcel. The 13 civilians would be hired locally for operation and maintenance positions if possible, but even if all 35 people with their families were brought in from outside the region, the induced population growth would be only 0.07 percent of the estimated 1979 Pueblo County population, an insignificant portion of the total area population.

Economic Impacts

Precise prediction of the economic impacts which will result from the aquisition of the parcel is difficult. Tax revenues on the land can be calculated accurately, but any estimates of loss of income due to reduction in cattle ranching on the parcel or income accruing to the region due to the presence of the Army is more difficult to predict. Two approaches have been used to attempt to estimate the degree of impact.

The first approach develops certain values for the production from ranches and for Army expenditures, based on what is known about the economic characteristic of the region around the parcel. The second uses the Army Corps of Engineer Construction Engineering Research Laboratory (CERL), Economic Impact Forecast Systems (EIFS) model to achieve a prediction of impacts. The model is limited in potential utility, since it was not designed strictly for application to this type of situation; i.e., a very remote land parcel with high proportion of per capita economic production, which is expected to have few permanent personnel located there. The model also is not programmed to account for the total loss in tax revenues when large amounts of land are removed from local tax rolls and not replaced with significant amounts of local development.

As a result, the most accurate means of predicting economic impacts includes a judicious comparison of the model results with what is known locally about the nature of the economy. Economic prediction is in any case a somewhat inexact science, and the model results represent a sample of the type of economic impact which could result from parcel acquisition. Results of the model runs should not be used as an absolute prediction, but as a general guide only. Details of the modeling process and results are contained in Appendix I, including Tables I-27 and I-28.

The primary economic impacts created by acquisition of the Huerfano River Parcel would result from a change in low density agricultural land use to a different type of use. The annual loss in value of the cattle/calf production for the area is estimated to be between 0.9 and 1.97 million dollars. The change in economy would remove some of the agricultural supply and support business, but this could be offset by some direct military expenditures in the area. The model results indicate a potential net loss of 86 jobs in the agricultural sector in the three-county area when the Balanced Use/Protection Scenario is compared with the loss of grazing activity. This number is an estimate and could be lower or higher for different use scenarios.

The overall impact of the loss of the grazing activity on the economy of Pueblo, Huerfano and Las Animas Counties would not be as significant as the model results predict, however, for two primary reasons. First, this region is dominated by the industrial base in the city of Pueblo. Second, not all of the money generated by the ranching operations on the parcel itself remains in this three-county region. Some of the money goes as profit to out-of-state cattle owners and some supplies and cattle feed are obtained from outside the region. (Personal communication, Andrew Marshall and Joe Ferris, April 28, 1980.) The exact amounts which are involved cannot be identified without unduly questioning individuals concerning their business affairs.

Loss of individual income[1] to ranchers and ranch hands who currently work in the parcel could be offset in several ways. Some of the ranch owners may retire or continue to manage ranch operations from another location. Ranch hands can move to other ranching or agricultural jobs in nearby locations; either group could be employed in some of the new positions made available by the acquisition of the Huerfano River Parcel. New jobs would also become available in the service sector, and for the two to three year construction period some additional jobs would be available.

Acquisition, Construction and Operation Impacts

The economic forecast shows that employment of 35 individuals, when multiplied throughout the economy, would affect a wide range of economic variables. Under the Balanced Use/Protection Scenario, creation of

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[1]Data are not available to determine accurately what the rancher's individual/family income may be. Ranch hands are paid between \$2.87 and \$3.71 per hour (Colorado Agricultural Statistics, 1979).

additional basic jobs at the parcel would add an estimated 81 positions locally in the service sector, due to the multiplier effect on the economy. The direct economic benefits would be an adjunct to the local economic base of the city of Pueblo, which is both close to the parcel and the dominant economic focus in the region. The additional employment represents 0.13 percent increase in the total employment for the three-county region and 0.16 percent increase for Pueblo.

A major unknown factor is the degree to which military expenditures would be shifted to the local area from Fort Carson. This cannot be accurately predicted because expenditures for "daily delivered items" such as food and petroleum would be made by private contract on a competitive bid basis. If merchants close to the Huerfano River Parcel are successful bidders for these contracts, the amount multiplied through the economy could be a moderate local economic stimulus. Estimated monthly amounts include $29,000 for daily delivered items and $120,000 for fuel per brigade training period. Acquisition of the Huerfano River Parcel could shift some of these contracts to Pueblo, Huerfano and Las Animas County sources, although it is possible that suppliers near Fort Carson could continue to provide some of these items.

Additional local expenditures would probably be connected with parcel acquisition, site facilities, construction, and continued operation beyond those projected through the CERL model output. Construction costs at the site are estimated to total slightly over $19 million (in 1977 dollars) (U.S. Army Draft Analysis of Alternatives Study, no date) (Table I-29). Costs in 1980 dollars would be over $27 million, and any estimate beyond those years would be expected to be considerably higher.

The degree to which opportunities for construction jobs would become available locally would vary as the site is developed. Contracts would be made with construction companies on a low-bid basis, and those companies would determine their needs for further employment. About twenty buildings would be built; lines for electricity, telephone, and pipelines for sewage, water and natural gas would be installed. Additional road construction and improvements would occur at the railhead. Most of this work would be completed within the first two to three years after acquisition and the number of construction workers would be variable during that time, though the EIFS model predicts a need for 536 employees per year during the construction period (Table I-30).

Expenditures connected with parcel acquisition would be a major source of economic benefit if they were brought into the local economy of the Spanish Peaks Region. The direct economic value of having the contract construction in the area is estimated by the Construction Model to be 2.2 million dollars per year for each of the 2 to 3 years of construction (Table I-30). This would have an effect on many sectors of the economy. As with other contract actions, although there is a potential for moderately beneficial impacts, the actual impacts of the construction projects cannot be predicted precisely because the ability of local businesses to win the bidding is not known. If local firms obtain this work the beneficial impacts to the local area would be far greater than if the work were contracted from outside the region.

Expenditures by individual military personnel located at the remote training site at the Huerfano River Parcel are expected to be minimal, since no passes would be issued from the site into any nearby communities. If any breaks in training occur, all troops would be bussed or trucked to Fort Carson. Any personal consumption by military personnel in nearby towns would be officially discouraged by the "no passes" policy.

Tax Base Impacts

Taking such a large parcel from the local tax rolls would have a slight impact on the overall local economy. Reducing the number of acres which support local government services, school districts, and county general funds would reduce the value of mills levied against the remaining taxable acres in the counties. The total reduction in tax income in Pueblo County would be $112,500 annually or 0.3 percent of the annual county revenue. Annual reductions in Las Animas and Huerfano counties would be $7,880 and $1,100, respectively, or about 0.06 percent of each county's income. In Pueblo County the District 70 schools would lose an estimated $32,000 annually or 0.73 percent of the annual revenue. About $550 would be lost to RE-1 Huerfano School District and $1,200 to Las Animas County schools (Colorado Division of Property Taxation, 1979).

Any increases in cost to schools and local government entities would be partially offset by added tax revenues on the anticipated increased property values, sales tax revenue and taxes on the income of additional individuals. State and Federal aid to schools in the area would also increase to provide support for an estimated 49 additional school children belonging to the portion of 35 employees who have families. Added costs to the region would be for public services, police and fire protection and a reduction in property tax revenue due to the development of this parcel. In Pueblo County, concern is growing about the gradual removal of various parcels from the local tax rolls, which could eventually mean a slight reduction in the level of services which the county would be able to offer.

Impact Summary

The socioeconomic impacts of acquiring the parcel vary depending on the elements of concern. For the people who own land and continue to ranch on this parcel area the impacts would be extreme. For those merchants who conduct business with the ranchers the impacts would be moderate to severe depending on how large a portion of his business was contributed by parcel area landowners. This impact of removal of this amount of beef production from the state economy would be slight, though it does represent an additional increment in an industry which has been dwindling in the past few years.

The total effect of removing the parcel from the local economy would have a slight to moderate effect on the tax revenue for the counties and school districts involved. The change in land use would be negligible because only 35 additional employees would be working at the site and none would live at the cantonment area. During the two to three year construction phase additional expenditures would boost the local economy and could provide a moderate beneficial impact. The operation and maintenance phase after the parcel is developed would provide a slight beneficial impact on the local economy.

Land Use

The purchase of the Huerfano River Parcel would convert 224,976 acres (91,048 hectares) from grazing activity to use for a remote training site. The estimated carrying capacities for cattle grazing of the site vary from 40 to 60 acres (16 to 24 hectares) per animal unit. At this rate it would in theory be possible to graze between 3,750 and 5,625 animal units on the area under consideration. In practice, the numbers have probably been in the middle of this range at any given time, due to varying management techniques among different ranchers (Personal communication, Bill Chandler, F.H.A., February 19, 1980). Limited grazing use may be combined with Army training activities (Section 2.4.1), but partial loss of grazing areas is certain and total loss is possible.

Residential development has not occurred in the vicinity of this parcel until recently, when some large-lot zoning has resulted in some expensive homes built in isolated locations within 5 miles (8 kilometers) of the northern boundary of the parcel. The city of Pueblo is expanding to the southeast, but this development is over 8 miles (13 kilometers) from the parcel boundary. Future growth is not projected to occur near the parcel.

Transportation Impacts

The most noticeable of the social impacts stemming from military use of the Huerfano River Parcel would be those associated with the transport of vehicles and personnel between Fort Carson and the remote site. Convoy movement on any highway would be highly visible. The lower speed of serials (convoys), about 40 miles (64 kilometers) per hour on the average, would attract the attention of other motorists who may be inconvenienced by the lines of military vehicles.

Plans to minimize these impacts are being formulated. Original plans included total reliance on highway transportation. Present plans now call for only wheeled vehicles to be driven to the site, and all tracked vehicles would be transported to the area by rail. The potential for disruption of faster-paced traffic by slow-moving serials is recognized and every effort would be made to move on highways during off-peak traffic times.

Rather than using local highways, such as Colorado 10, Highway U.S. 350, or Doyle Road, convoys would travel on the Defense Highway System and use Interstate Highway 25 (I-25). Facilitating the movement of military traffic is the original reason for the construction of the Interstate or Defense Highway Access System. The addition of military convoys is not expected to conflict with traffic volumes on I-25, but the overall disruption would be less than if two-lane undivided highways were used for access to the parcel. In addition, I-25 and its bridges are better constructed than other roads and bridges designed for lower weight vehicles and lower traffic volumes.

The study of access routes to the Huerfano River Parcel (U.S. Army, 1978) analyzed the available transportation routes. Three "most feasible" routes were identified, all using I-25 from Fort Carson to Pueblo. The first would then follow U.S. Route 50 to 36th Lane, to Doyle Road, southeast to a cantonment on the northern edge of the parcel. This route is not favored because of the significant impact on several thousand residents of Pueblo and the small communities such as Vineland and Devine along these roads. The roads south of U.S. Highway 50 are gravel and would have to be upgraded for military use.

A second route followed I-25 beyond Pueblo to Walsenburg and proceeded northeast on Colorado Highway 10 to the Red Top Ranch Road. The trail leads to a network of gravel roads inside the parcel. This route is not favored due to added distance from Fort Carson, lack of suitable rail access and the poor condition of Highway 10, an old narrow route currently in need of maintenance and rebuilding. The District 2 Colorado Highway Engineer's Office recommends against using Highway 10 (Personal communication, H. W. Harris, February 6, 1980).

The preferred alternative would move serials down I-25 to the Colorado City Exit (#77) and east to Cedarwood, the proposed cantonment site. An existing rail siding at Cedarwood would facilitate rail transport of all tracked vehicles. The 13-mile (21-kilometer) road to Cedarwood is gravel and would have to be up-graded. Fewer local residents would be affected by this choice than along the other routes, and use of I-25 would be maximized.

Added traffic volumes would probably cause some additional wear on I-25. However, the actual number of added vehicles would be relatively small. The entire convoy would be composed of about 826 vehicles including primarily jeeps and half-ton to 2.5-ton trucks, with a few 5.8- and 10-ton trucks, all of which are similar to regularly used civilian vehicles. The serial would be spaced in 25 company units of about 33 vehicles each, with an average distance of 492 feet (150 meters) between vehicles. A serial would be moving on the highway during approximately two days per month during the months when training exercises were being conducted. With the rest periods planned for the parcel, the average highway use by serials would be about one day per month. This could result in some reduction of highway capacities during periods of serial use. It is possible that highway safety would be adversely affected, though the design capacities of the highways are sufficient to handle the additional use (Personal communication, Harvey Atchison, April 21, 1980).

The impact on rail transportation would involve two rail lines, the Colorado and Southern (CS) northbound and the Denver Rio Grande and Western (DRGW) for southbound traffic. Two 85-car trains would be required to move needed tracked equipment to the parcel for training use. About three hours would be required enroute, after loading, to move from Fort Carson to Cedarwood. The Army would execute agreements with these railroads for freight service and would avoid possible conflicts with increasing coal train traffic.

Air transport and aircraft movement would be the only other transportation-related impact. Army helicopters and fixed-wing aircraft from the Air Force would be the most frequently used aircraft at the Huerfano River Parcel. They would be flown to the remote site according to the prevailing civilian flight rules of FAA. Helicopter use on the site would follow the nap-of-the earth (NOE) mode, i.e. fly below radar detection levels for manuevers, approximately 200 feet (61 meters) above ground level (agl) and lower. No airfield would be built, but a helicopter landing pad would be installed at the parcel.

The Terminal Control Area airspace for the Pueblo Airport would experience a moderate impact from activities at this parcel, as more than 50 percent of the area is covered by Pueblo Approach Control Radar. The Pueblo controllers feel that some restriction of airspace is possible, but that aircraft could be successfully vectored around the area on any days of potential conflict. A restricted airspace zone over this parcel would not be needed since there would be no live firing (U.S. Army, Draft Analysis of Alternatives Study, no date).

Energy Use - Impacts and Mitigation

The consumption of energy fuels would comprise an irretrievable commitment of resources. The chosen route to reach the parcel would be the shortest of the three highway choices, and the decision to use rail transport, instead of trucking the tracked vehicles, would also save fuel. Conducting Army training involves the consumption of fuel, however. Current estimates indicate fuel requirements of 65,000 gallons (245,960 liters) of diesel fuel and 26,000 gallons (98,384 liters) of gasoline per brigade training period. The average fuel consumption per vehicle would be 3.7 miles per gallon.

Army fuel needs, as far as local fuel allocations are concerned, should have minimal impact. Even if fuel rationing occurs, the Army requirements would be considered separately from those of area residents. Heating fuel, of course, would have priority over transportation fuel. Even if local distributors are successful bidders in providing Army fuel supplies, those supplies available to residents in the vicinity of the Huerfano River Parcel would not be expected to be reduced.

4.1.9 Cultural Resources

The wealth of cultural resources that exists within the Huerfano River Parcel, ranging from pre-historic archaeological to recent historical artifacts, could be affected by military training and land management activities.

The Colorado Natural areas program has expressed interest in designating the area of the Huerfano/Cucharas Canyon as a site of scientific interest. The area of concern closely follows the proposed wildlife protection area for the canyon (see Figure 3-16). The designation of this area as a state natural area would be supported if the Huerfano River Parcel is acquired. Any portion of the Huerfano River canyon that would be obtained would have limited utility for maneuvers, would be fenced and kept as set-aside areas, buffer zones and wildlife protection areas, and could easily be included as part of a designated natural area.

In addition to the canyons, uplands locations on the Red Top Ranch in the eastern part of the parcel have been discovered to have a similar wealth of artifacts. A master's thesis was prepared at Colorado College during the 1970s based on this area (Anderson, 1972). The discovery of artifacts throughout the parcel gives an indication of the extent of early man's activity in the area.

The variety and extent of cultural resources already identified on the Huerfano River Parcel indicate that further study is necessary. A Memorandum of Understanding has been entered into between the U.S. Army and Colorado's State Historic Preservation Officer. Under this agreement, a copy of which is included in Appendix I, a complete survey of the parcel would be conducted to identify and record any cultural resources in the area. Any land acquired would be surveyed and protection measures implemented prior to the initiation of maneuver training.

According to professional archaeologists who have surveyed the present Fort Carson property, a variety of sites are probably present on the Huerfano River Parcel. The sites are not confined to the canyons but are present on the uplands as well. (The sites in the canyon areas represent early agricultural cultures, while those on the uplands represent primarily hunting and gathering cultures.) Once the site survey is completed, the inevitable disturbance by tracked vehicles of surface remnants, such as lithic scatters, is not thought to be a critical problem, since the data concerning the cultural remnants will be on file. For Fort Carson archaeological sites, Army management has preserved such things as rock art and materials in the canyons in good condition (Personal communication, Bob Alexander, May 8, 1980).

4.2 PINON CANYON PARCEL

Military training on the parcel would be conducted according to the Land Use and Management Plan discussed in Section 2.5. Military use of the Pinon Canyon Parcel would alter existing environmental characteristics of the parcel. Beneficial and adverse impacts are assessed in this section and measures are described to mitigate adverse impacts. Impacts have been assessed based on the preferred boundaries for the parcel. However, impacts resulting from military training activities would be essentially equal for the area included within the offered boundaries.

4.2.1 Geology/Minerals

The proposed military activities associated with the acquisition and use of the Pinon Canyon Parcel by the U.S. Army would have little effect on the geology of the area regardless of the scenario used. Impact on the proposed designation of the Red Rocks Canyon and Purgatoire River Canyon as a National Natural Landmark is discussed in Section 4.2.9.

No presently or potentially economic deposits of mineral or energy resources would be disturbed by the proposed action. The only foreseeable impact of the proposed military activities would be the removal of approximately 262,262 acres (106,137 hectares) from future exploration for minerals and fuels. However, according to current mineral reserves estimates, uranium is the only mineral commodity that may be affected by land withdrawal.

4.2.2 Soils

Training Use

The impact of training on the soils of the Pinon Canyon Parcel would depend upon the pattern and intensity of use on the landscape. Impacts can be approximated from the generalized scenario presented in section 1.4.5 but may differ from actual patterns of use that emerge as training proceeds.

The impacts occurring on the parcel would include severe and extreme reductions in vegetative cover resulting from repeated vehicle passes, bivouac sites and tank turns. These are expected to be concentrated in the mapping units that have topographic diversity and strategic cover, including LS (Loamy Plains - Sandstone Breaks Complex) MPD (Loamy Plains Limestone Breaks Complex), PR (Limestone Breaks - Pinyon-Juniper Complex) and trafficable portions of TrG (Pinyon-Juniper Rockland Complex), and in the AP (Alkaline Plains) and uprotected SE (Saline Overflow, eroded) units which occur adjacent to the limestone cliffs. Impacts are similar to those discussed in Section 4.1.2.

The response of the soil-range mapping units of the parcel to training use depends in a large part on the nature and amount of cover protecting the surface, including vegetation, litter and rock cover. Average values obtained from multiple examination points within the parcel during the conduct of field studies during November and December 1979 are shown in Table 4-13. The baseline cover is the average

TABLE 4-13

AVERAGE BASELINE AND RESIDUAL COVER, PINON CANYON PARCEL

Mapping Unit Symbol	Range Site Components	Baseline/Cover of Vegetation, Rock and Litter (percent)	Residual Cover of Rock and Litter (percent)
LP	Loamy Plains	20	2.5
LS	Loamy Plains - Sandstone Breaks Complex	26	7.5
PR	Limestone Breaks - Pinyon - Juniper Complex	79	48.0
MPD	Loamy Plains - Limestone Breaks Complex	22	8.0
SO	Saline Overflow	20	4.0
TrG	Pinyon - Juniper - Rockland Complex	53	38.0
AP	Alkaline Plains	22	11.0
SE	Saline Overflow, eroded	24	2.0
SaP	Sandy Plains	39	7.0
SM	Salt Meadow	22	2.0

condition of vegetative litter and rock cover now present on the surface; residual cover is the amount of cover that would remain if all live vegetative cover were destroyed for each mapping unit. Many of the units have a residual cover of rock and litter that will remain even after all vegetative cover has been removed.

Soil Impacts Resulting from Loss of Vegetative Cover

Moderate reductions in vegetative cover would occur in the open areas (mapping units LP, SO, and SaP) which would experience random traffic movement in most exercises. Areas that are not suitable for military training exercises would experience slight and negligible impacts. Because grazing is removed as an impact, it is anticipated that the vegetative cover would improve and that present soil erosion would also be slightly reduced.

The overall result of vegetative cover reduction in moderate, severe and extremely impacted areas would be to expose soil surfaces to water and erosion. As shown in Figure 3-19, areas of moderately steep slopes (units PR, MPD, TrG and portions of LS) and high runoff rates (AP, SE) units) would have the greatest water erosion increases when disturbed. Areas without tree cover (LP, AP, SO, SE, portions of LS and MPD) would experience the highest wind erosion increases (Figure 3-20).

Physical impacts to the soil including pulverization of the existing surface crust, compaction and rut formation would occur in areas impacted by traffic movement. Damage to the surface crust will be a short-term moderate impact as discussed in Section 4.1.2. Compaction and rutting would be prevented on most mapping units by halting maneuvers during periods of excessive moisture as specified in the LUMP. The mapping units formed in shale, however, would experience compaction and rutting at all moisture levels. These include the AP (Alkaline Plains) and SE (Saline Overflow, eroded) mapping units, which occur at the base of limestone cliffs and adjacent to drainages in a significant area of the Pinon Canyon Parcel. The SE (Saline Overflow, eroded) unit has been eroded severely enough to alter its character from one of deposition to one of soil removal and subsequent exposure of the underlying shale. This unit has very little tolerance for additional water erosion before severe downcutting and gullying occur. Careful monitoring is therefore necessary. The AP (Alkaline Plains) unit is also very prone to high water erosion losses and would begin irreversible downcutting and gullying, if mitigation measures are not rapidly applied after impacts occur. Both units have low stability ratings and vegetative cover would be difficult to reestablish if it is severely reduced. Mechanical treatments to shorten slope lengths, roughen the surface and artificially protect the surface would probably have to be rapidly applied to prevent severely and extremely impacted portions of these units from irreversible damage from gully formation.

In the Increased Use Scenario, full recovery in most mapping units that have experienced a reduction in vegetative cover would occur only in years with adequate, timely precipitation. Recovery on the units that are difficult to revegetate and on those that are inherently unstable (including the AP and the SE units), should not be anticipated in this scenario. Artificial soil surface protection would be necessary. If the intensity of training precludes rapid mitigation in those areas, some portions of those units could be irreversibly damaged by gully formation and head cutting, a process that is costly and very difficult to stop once it has begun (Shumm, 1977).

In the Increased Protection Scenario, full recovery in most mapping units, if aided by seeding in areas of extreme impact, could be expected to occur on most areas. This would result from the longer period of deferment during the growing season each year, the 3-year rest of land units during rotation, and deferment during drought. Careful mitigation of the AP and SE units would be necessary but should be possible to accomplish between training exercises due to the small extent of those units.

Table 4-14 indicates the amount of land that would be expected to be impacted and the predicted level of impact for each scenario. Moderate impact represents the present level that occurs on the parcel.

4.2.3 Vegetation

The impacts created by military training use on the Pinon Canyon Parcel would be expected to closely resemble the impacts on the Huerfano River Parcel (Section 4.1.3 and Tables 4-3, 4-4 and 4-5). This information is applicable to the Pinon Canyon Parcel because of the similarity of the plant species and the plant communities of the same range sites present on both parcels. A significant exception to this is that the designated endangered plant species, Haplopappus fremontii monocephalus, is known to occur on the Pinon Canyon Parcel but was not discovered on the Huerfano River Parcel during vegetative inventories in 1979. To guard against destroying the plant habitat on the Pinon Canyon Parcel the same off-limits policy for key areas would be enforced. The Saline Overflow, eroded, range site on the Pinon Canyon Parcel would be declared off-limits.

Predicted land disturbance by military training operations (Table 4-15) would result in levels of disturbance that are between negligible and moderate on 65 percent of the Management Units in the Increased Protection Scenario; 55 percent in the Balanced Use/Protection Scenario and 45 percent in the Increased Use Scenario. These percentages of land areas could be spared from highly destructive impacts and could be maintained in protective and productive vegetative cover. Management Units predicted to experience extreme to severe Levels of impacts would be of primary environmental concern. Treatment and management of these areas would be of utmost concern to prevent their degradation.

TABLE 4-14

PREDICTED LAND DISTURBANCE FOR THE ENTIRE PINON CANYON PARCEL[a]

Use Scenario	Levels of Impact on Land Disturbed (percent)[a]				
	Negligible	Slight	Moderate	Severe	Extreme
Increased Protection	18	24	24	24	10
Balanced Use/ Protection	13	19	24	34	10
Increased Use without Unit F	8	15	24	39	14
Increased Use with Unit F	8	15	24	39	14

[a]This includes all off-limits and restricted use area, which will experience negligible impacts.

TABLE 4-15

PREDICTED LAND DISTURBANCE FOR TRAINING AREAS,
PINON CANYON PARCEL

Use Scenario	Levels of Impact on Land Disturbed (percent)[b]				
	Negligible	Slight	Moderate	Severe	Extreme
Increased Protection	15	25	25	25	10
Balanced Use/ Protection	10	20	25	35	10
Increased Use	5	15	25	40	15

[b]This includes land actually available for training use and does not include off-limits and restricted use areas.

Net change in existing vegetative cover.

Negligible	+20%	Severe	->40%
Slight	+10%	Extreme	->80%
Moderate	- 0%		

Vegetation within the wildlife protection areas along the Purgatoire River Canyon would have the opportunity to make growth with little if any disturbance.

4.2.4 Hydrology

<u>Suface Water Impacts</u>

Sedimentation

Increased sediment loading is anticipated to be the most significant potential impact on surface waters in the Pinon Canyon Parcel. Refer to Section 4.1.4 for a general discussion of sedimentation. The projected maximum sediment yields for anticipated average annual runoff conditions in the parcel estimated for military training in the major watershed areas are presented in Table 4-16. Levels of impact are also noted. As discussed for the Huerfano River Parcel in Section 4.1.4, the potential annual incremental increase in sediment yields would be limited for the most part, to the management unit in which military training would take place in any given year. The maximum sediment yields in the parcel would occur under the Increased Use Scenario.

Salinity

Increased salinity in surface waters in the Pinon Canyon Parcel is also anticipated. Salinity in surface waters in the region is discussed in Sections 3.2.4 and 4.1.4. Based on reduced cover conditions discussed in Section 4.2.2 and Appendix C, salinity levels in surface waters in watersheds in the parcel, could vary considerably by location, as discussed in Section 4.1.4. Mitigation measures for salinity control that are addressed in Section 4.1.4 would also be applicable for this parcel.

Surface Water Use

The provision of potable water is an unresolved issue. A surface water supply source from the city of Trinidad had been proposed for domestic uses in the cantonment area and in the field. This water supply source for the parcel, treated or untreated, would be conveyed by pipeline to the cantonment area where it would be stored, treated as necessary, and distributed to points of use. However, it is anticipated that further studies on this water supply issue will be required. However, a more recent proposal would result in development of reported water at or near the cantonment site, thereby eliminating the requirement for a major pipeline. Regardless of the eventual resolution of this issue, the water required and potential impacts are similar to those presented in Section 4.1.4. Additionally, no monetary value is placed

TABLE 4-16

PROJECTED POTENTIAL MAXIMUM LOCAL SEDIMENT YIELDS IN MAJOR WATERSHED AREAS WITHIN PREFERRED BOUNDARY OF PINON CANYON PARCEL[1]
(includes all military use scenarios)

Designated Watershed Unit Name in Parcel[2]	Drainage Area (square miles)	Projected Sediment Yield[1] (tons/square mile/year)	Percent Local Increase Over Baseline Conditions	Projected Potential Impact in Watershed Area[3]
Sheep Canyon Arroyo	0.4	1,400	13	moderate
Local Area to Timpas Creek Drainage	31.5	1,590	17	moderate
Local Area to Simpson Lake (non-contributing area in Timpas Creek Drainage)	4.7	620	24	severe
Local Area to Luning Arroyo	5.8	1,410	18	moderate
Van Bremer Arroyo	64.5	1,010	10	slight to moderate
Taylor Arroyo	84.0	1,150	7	slight
Lockwood Arroyo	60.1	1,780	30	extreme
Red Rock Canyon	55.2	2,360	6	slight
Bent Canyon	70.5	2,420	7	slight
Minnie Canyon	9.4	2,580	14	moderate
Local Area to Purgatoire River (western portion)	14.3	2,190	12	moderate

[1] Values are for assumed battalion training in given watershed area; the largest contiguous maneuver area suitable for battalion training contains about 34.4 square miles (Dames & Moore, 1977).

[2] Refer to Figure 3-22 for watershed locations.

[3] Impact evaluations do not include off-limits and restricted use areas, which would experience negligible impacts.

NOTE: Local area refers to contributing intervening drainage area between major watershed divides.

Based on U.S. Department of Agriculture, 1980:
- Very High Sediment Yield - 5100 tons per square mile per year
- High Sediment Yield - 1700-5100 tons per square mile per year
- Moderate Sediment Yield - 850-1700 tons per square mile per year
- Low Sediment Yield - 340-850 tons per square mile per year
- Very Low Sediment Yield - less than 340 tons per square mile per year

Conversion Factors:
- 1 square mile = 259,093 hectares (approximately)
- 1 ton/square mile/year = 2.8×10^{-6} m^3/hectare/year (approximately)

on the existing surface water rights (Table 3-20) in the Pinon Canyon Parcel (J.W. Patterson & Associates, Inc., 1980). These water rights are discussed further in Appendix E.

Impacts concerning considerations to dissolved oxygen, flow variations, oil spills and other hazardous/toxic substances, sewage treatment, and disposal of solid wastes would be similar to those for the Huerfano River Parcel. In addition, practices for controlling and/or identifying potential adverse impacts on surface water quality in the Pinon Canyon Parcel will also be the same as discussed for the Huerfano River Parcel (Section 4.1.4).

Ground Water Hydrology

If ground water is utilized as a water source for the cantonment area, impacts would be similar to those discussed in Section 4.1.4, because the characteristics of the water-bearing strata are essentially the same.

4.2.5 Wildlife

Terrestrial Ecology

Impacts to wildlife resources which would occur on the Pinon Canyon Parcel are similar to those which would occur on the Huerfano River Parcel (Section 4.1.5). However, the following additional impacts might also occur.

Data indicate that Scaled Quail densities on the Pinon Canyon Parcel are approximately twice those of the Huerfano River Parcel (see Appendix F). Therefore, impacts to Scaled Quail populations on the Pinon Canyon Parcel are expected to be more severe. Turkeys occur on the Pinon Canyon Parcel but not on the Huerfano River Parcel. Their preferred habitat is brushy areas which occur along canyon rims in conjunction with Pinyon-juniper communities. Since these are areas preferred for bivouac activity, impacts to Turkey population would be severe.

The Colorado Division of Wildlife is considering transplanting Bighorn Sheep into the Purgatoire Canyon area. Noise and increased human activity from military maneuvers would have a detrimental impact on these sheep and might threaten the success of the transplanting operation. The Colorado Division of Wildlife is also considering planting a pair of Peregrine Falcons in Purgatoire Canyon. Noise and human activity during breeding season would have a moderate impact on the success of this proposed action.

Mitigation measures on the Pinon Canyon Parcel would be similar to those for the Huerfano River Parcel (Section 4.1.5).

Aquatic Ecology

Impacts to the permanent aquatic ecosystems on the Pinon Canyon Parcel resulting from the proposed military training and related activities are anticipated to be insignificant if all proposed mitigations are implemented. The turbidity of the aquatic environment which is caused by natural erosion and high salinity levels resulting from upstream irrigation return flows, would not be reduced by Army use of the parcel. Suspended solids in the waterways may increase during maneuvers, from the upland areas through wind erosion and runoff. The increase in turbidity and salinity from soil erosion and runoff would reduce the primary production of the stream ecosystem and lessen the habitat potential for some fish species through lowered dissolved oxygen (DO) levels and higher total dissolved solids (TDS). The turbid and silty habitat is also undesirable for fish spawning, and abrasion and clogging of gills results. The number of fish species tolerant to such conditions is very low.

Water quality conditions may also worsen through accidental release of hazardous substances, radiological, acid, alkaline or toxic wastes. The result would be eutrophication, fish kills and a more undesirable aquatic habitat. However, because of Regulation 200-1, which details the Fort Carson Environmental Program's hazardous/toxic materials management objectives and responsibilities, adverse impacts are not expected.

A possible beneficial impact that would result from acquisition of the land is that ranching would discontinue on the parcel. Cattle grazing would be reduced significantly, therefore reducing the contribution to the already high fecal coliform level.

Mitigation Measures

Presently, the Purgatoire River reportedly contributes significantly to the high dissolved salt concentrations in the Arkansas River (Misbach, 1973). However, erosion, sediment and runoff control measures in the Pinon Canyon Parcel would reduce the contribution of sediment to the lower reaches of the Purgatoire River. This would be accomplished by crossing the Purgatoire River only at an improved bridge location. Also, other stream crossing locations would be riprapped to limit potential erosion from channel bed and banks. This is important protection because these rivers are classified as moderate to limited fishery resource areas (Colorado Division of Wildlife, 1979).

The maintainance of perennial stock ponds and reservoirs would help to provide improved habitat for aquatic organisms. Stocking of tolerant fish species might be possible providing that the water quality and aquatic habitat shows improvement after a few years. Willows and appropriate shrubs planted along the edges of the Purgatoire River and its tributaries on the parcel would reduce evaporation and erosion. The shady cooler stream environment would provide a more suitable habitat for aquatic vegetation and animals.

Upon purchase of the property, the Army would perform a comprehensive fisheries inventory of the parcel. This study would confirm the presence of any significant species. For example, if either of the two (2) threatened fish, Arkansas River Darter or Arkansas River Speckled Chub occur on the parcel, the Army would institute consultation with the Colorado Division of Wildlife to ensure protection of the species.

4.2.6 Meteorology and Air Quality

Introduction

The Pinon Canyon Parcel is located in Las Animas County, which from an air quality point of view, is very similar to the Huerfano River Parcel. The background concentration of particulates in Las Animas County is about 30 $\mu g/m^3$ (Colorado Department of Health, 1979). Because of the soil types that exist in the area, particulate emissions from vehicle movement and wind erosion are expected to be large.

Because the Pinon Canyon Parcel would have the same training activities as the Huerfano River Parcel, little difference in the emissions inventory and subsequent dispersion modeling exists between the two parcels. Because of these small differences, only the particulate analysis is presented. The emissions of sulfur dioxide, carbon monoxide, and nitrogen oxides would be slightly reduced since only 4.7 brigade-size training periods would be permitted instead of 4.8. Therefore, since none of these pollutants had a significant impact on the Huerfano River Parcel, their impact on the Pinon Canyon Parcel is also expected to be insignificant.

Particulates

Criteria Used to Estimate Emissions and Results

As stated in Section 4.1.6, the primary sources of particulate emissions would be vehicle movement and wind erosion from severely impacted land. While the Pinon Canyon Parcel has a different off-road effective silt content and cover, these two factors would act to offset each other resulting in only a net 0.24 percent reduction in particulate emissions per brigade-size training period. The particulate emissions inventory in Appendix G presents further detail. Additional information concerning the 0.24 percent reduction in particulate emissions is also presented in Appendix G.

The other particulate source that would change from the Huerfano River Parcel to the Pinon Canyon Parcel is the emission from wind erosion. In order to estimate the emissions from wind erosion, an estimate of the acreage of land that would be impacted to the extent of having less than a 20 percent effective cover was performed. Details of the calculations of wind erosion emissions are presented in Appendix G.

Table 4-17 presents a summary of worst-case annual particulate emissions for the Pinon Canyon Parcel. The worst-case annual particulate emissions would result when training occurs on the largest three land management units ABC and the Increased Use Scenario LUMP is assumed.

TABLE 4-17

WORST-CASE PARTICULATE EMISSIONS INVENTORY
INCREASED USE SCENARIO, MANAGEMENT UNITS ABC
PINON CANYON PARCEL

SOURCE	PARTICULATE EMISSIONS, TONS PER YEAR (TPY)
Wheeled vehicle movement[a]	7323.8
Tracked vehicle movement[b]	2843.7
Wind erosion	2922.2
Tail pipe, gasoline vehicles	0.9
Tail pipe, diesel vehicles	2.7
Space heating	14.6
Aircraft	1.4
TOTAL	13,109.3

[a]Based on 73.3 percent of the total brigade-size vehicle fleet being in training area.

[b]Based on 84.7 percent of the total brigade-size vehicle fleet being in training area.

Results of Dispersion Modeling and Comparison to Existing Levels and Standards

Worst-case annual particulate concentrations on the Pinon Canyon Parcel would be different from those presented on the Huerfano River Parcel but training intensities would not change on the Pinon parcel. Therefore, the worst-case 24-hour area source and line source calculations would not change. However, changes would occur with the annual particulate concentration because of area source configuration.

The CDMQC dispersion model was used to estimate the impact on the annual standard. Worst-case analysis was performed assuming training would occur on units ABC. In addition to having the worst-case emissions, units ABC lie closest to the population center to the west of the parcel than any other three land management units.

After obtaining the annual emissions inventory for the Pinon parcel, the CDMQC dispersion model was run. The sources of emissions were distributed in the Pinon Canyon Parcel the same way they were in the Huerfano River Parcel; sources such as vehicle movement and tail pipe emissions were distributed evenly in ABC training units, whereas space heating emissions were distributed evenly in the cantonment area. Figure 4-3 presents the results of the dispersion modeling for the annual case. All of the indicated particulate concentrations include a 30 $\mu g/m^3$ concentration added as an estimate of existing background concentrations (Colorado Department of Health, 1979).

Results of the modeling indicate receptor particulate concentrations along the property boundary ranging from 31.2 $\mu g/m^3$ in the extreme northeast section of the parcel to 38.6 $\mu g/m^3$ in the west and northwest section of the parcel. At the population centers of Trinidad, Tyrone, Thatcher, and Houghton, annual concentrations were calculated to be 31.6, 35.6, 35.7, and 33.7 $\mu g/m^3$, respectively. All of these concentrations are below the Colorado annual standard of 45 $\mu g/m^3$. Receptors inside the borders showed concentrations ranging from 39.4 $\mu g/m^3$ to 51.4 $\mu g/m^3$. The receptor which received the estimated concentration of 51.4 $\mu g/m^3$ is located about where the annual concentration is expected to be the highest.

From the Huerfano River Parcel analysis, 24-hour worst-case area source calculations indicated that while the concentrations arising from an area source would not pose a problem on the Pinon Canyon Parcel, concentrations resulting from road traffic (19 companies convoying on same road in 24 hours) would violate the Colorado 24-hour standard within 500 meters of the road surface. (See Huerfano Section 4.1.6 and Appendix G for details.)

Impacts and Mitigation

As was the case with the Huerfano River Parcel, mitigation measures have already been incorporated in the preceding analysis. All main trails, as defined in the glossary, would be graveled to reduce particulate emissions and wind erosion mitigation measures would be incorporated to reduce emissions from exposed ground (see Section 4.2.2, Soil Impacts and Mitigation).

Impacts of the proposed training on the Pinon Canyon Parcel are almost the same as the impacts on the Huerfano River Parcel with the exception of the nonattainment area of Pueblo. Impact on the annual particulate concentrations off the parcel will be slight to moderate. The towns of Thatcher and Tyrone would receive an estimated increase in particulate concentrations of about 19 percent each. Inside the parcel, the annual geometric mean standard is expected to be exceeded. With exceedance of the standard, Colorado Department of Health would probably require restriction of public access to the parcel during training.

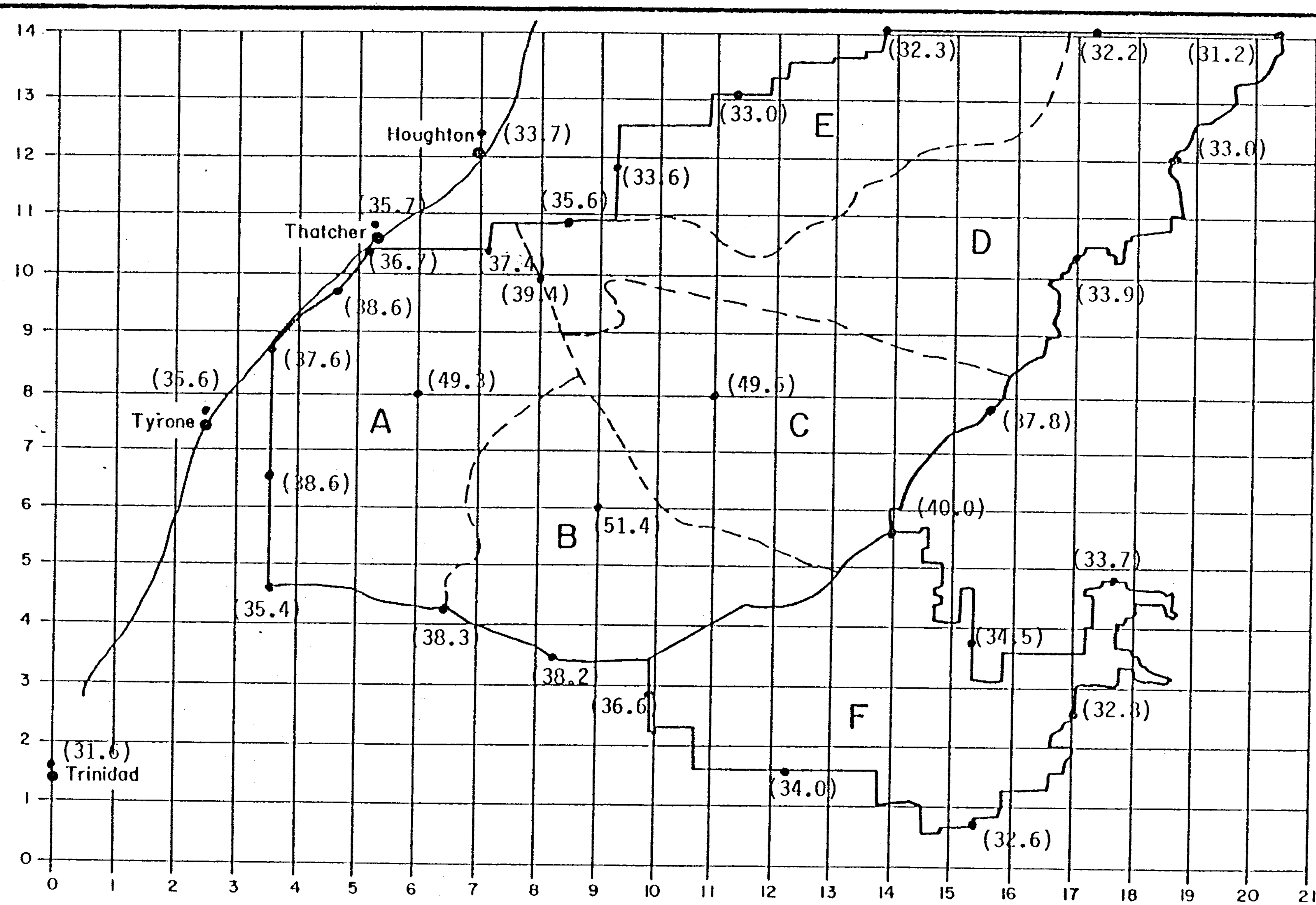

FIGURE 4-3

PINON CANYON PARCEL

WORST-CASE ANNUAL PARTICULATE CONCENTRATION, INCREASED USE SCENARIO TRAINING AREA ABC ($\mu g/m^3$)

The 24-hour standard is expected to be exceeded within 500 meters of any road surface having the traffic described in the Worst-Case Line Source Calculation found in Appendix G. While this traffic volume would probably occur only rarely and only on the main road leading out of the cantonment area into the training area, the Army would not locate this road within 500 meters of the property boundary or would pave the road in the sections where it would lie within 500 meters of the property boundary. The paved sections of roads would be restricted to wheeled vehicle travel only. Tracked vehicles would be required to travel on an additional graveled road for those sections. (Wheeled vehicles emit 72 percent of the total emissions and therefore it would be sufficient to mitigate only that portion of the total emissions.)

As in Section 4.1.6, the Army would conduct a monitoring program in the interim between acquisition and training. The monitoring program on the Pinon Canyon Parcel would be precisely the same as the Huerfano River Parcel with the exception that one of the high volume samplers would be placed in Thatcher. Refer to Section 4.1.6 for further details of the monitoring program.

Carbon Monoxide, Nitrogen Oxides, and Sulfur Dioxide Summary

Because the two training parcels would be used the same way, the emissions of carbon monoxide, sulfur dioxide and nitrogen oxides would be almost the same on the Pinon Canyon Parcel as on the Huerfano River Parcel but slightly lower since the largest training on the Pinon Canyon Parcel would only support 4.7 brigade-size training periods per year instead of 4.8. Further details of these calculations are presented in Section 4.1.6. All of these pollutants would have negligible impacts, so no mitigation measures were considered.

4.2.7 Sound

Noise producing training activities at Pinon Canyon Parcel would be the same as for the Huerfano River Parcel. Noise impacts as evaluated one mile from the parcel boundary would also be the same except that the region around the Pinon Canyon Parcel is less densely populated, thus reducing the overall impact slightly.

Table 4-18 shows the background ambient sound levels at the Pinon Canyon Parcel measurement locations (see Figure 3-13) and the ambient sound level changes attributable to the proposed activities. Although the sound level changes (increases) would be larger than for the Huerfano River Parcel measurement locations it is because the Pinon Canyon measurement locations are close to the parcel and the existing background ambient sound levels are low. Even though the noise effects attributable to training activities will be essentially the same for each of the two parcels, the noise impact at the Pinon Canyon Parcel would be lower because fewer people would be exposed.

TABLE 4-18

PRESENT AND PROJECTED SOUND LEVELS AT MEASUREMENT LOCATIONS AT PINON CANYON PARCEL

Location	Background Ambient Sound Level, L_{dn},d	Combined Training Activity and Background Ambient Sound Level, L_{dn}, dB	Change, dB
1	44.2	73.6	+29.4
2	43.8	58.3	+14.5
3	34.8	57.4	+22.6
4	58.1	60.0	+ 1.9
5	49.2	53.6	+ 4.4

Jet aircraft flying at low altitudes (1,000-5,000 feet; 305-1524 meters) on approach and departure from the parcel would more easily avoid exposing ranches and homes to direct overflights. Furthermore, fewer restrictions on flight patterns to avoid the outskirts of Pueblo would be necessary than at the Huerfano River Parcel. Transportation of troops, vehicles and supplies over the additional distance to the Pinon Canyon Parcel would not appreciably increase the noise impact compared to the Huerfano River Parcel because population is extremely sparse along the affected road and railroads. The noise impact of jet aircraft in transit over the additional distance will be negligible, but helicopters may cause a slight impact at isolated ranches along their route.

Mitigation measures for training activities, convoys, helicopter and jet aircraft are the same as for the Huerfano River Parcel (Section 4.1.7).

4.2.8 Socioeconomics, Land Use and Transportation

The Pinon Canyon Parcel is located about 35 miles (56 kilometers) southeast of the Huerfano River Parcel in a portion of Colorado which is very homogeneous in economic and population aspects. The area is sparsely populated, singular in agricultural land use and generally stable economically, although not wealthy. Pertinent background data which is equally applicable to impacts for both parcels is included in Section 4.1.8 concerning the Huerfano River Parcel.

Population Impacts

Population changes for this site would include the displacement of an estimated 46 people, including families and single individuals, all of whom live in Las Animas County on the ranches included in the Pinon Canyon Parcel. Approximately 10 of these are children and the rest are adults assumed to be engaged in ranching on the parcel (Personal communication, Butch Hall, February 8, 1980). Relocation assistance discussed in Section 4.1.8 is applicable in this parcel.

Operation and maintenance of the Pinon Canyon Parcel would require about 35 people to be located near the parcel. Thirteen would be civilians and 22 would be military personnel, none of whom would live at the site. Trinidad or possibly La Junta, Hoehne or some of the very small communities along U.S. 350 might be potential locations for some of these people to settle. This represents 0.2 percent of the Las Animas County population.

Economic Impacts

The primary economic impacts that would be created by acquisition of the Pinon Canyon Parcel would be concentrated in the change from a low density agricultural land use to military use. The annual loss of the value of the cattle/calf production for two areas is estimated to be between 0.88 and 1.4 million dollars. The change in economy would negatively impact some agricultural supply and support businesses resulting in the loss of approximately 67 jobs in Las Animas and Otero Counties. As discussed in Section 4.1.8, the overall impact of this on the economy of Las Animas and Otero Counties would not be as significant as the model results indicate.

Acquisition, Construction and Operation Impacts

Under the Balanced Use/Protection Scenario, creation of the 13 civilian jobs and 22 added military personnel would add 89 jobs locally in the service sector, due to the multiplier effect through the economy. This is a 1.7 percent increase in employment for Las Animas County and a 0.8 percent increase for Otero County. Due to the economic dominance of Trinidad in Las Animas County and its proximity to the parcel, it is assumed that most of the positive economic impact would occur there, though it is possible that La Junta would experience some economic benefit. All of the impacts connected with construction activities at the Huerfano River Parcel apply equally to the Pinon Canyon Parcel.

A moderate negative impact would occur on the local tax base due to the removal of a large parcel from the local tax rolls. Reducing the number of acres supporting the local government services, school districts, and county general funds has the effect of reducing the value of the mills levied against the remaining acres in Las Animas County. The reduction in tax income would be $59,232 annually, or 1.8 percent of the county revenue (Colorado Division of Property Taxation, 1979).

The CERL EIFS model predicts a net annual increase in cost to schools of $25,000 and additional local government costs of about $68,000 for this two-county area, most of which would be experienced in Las Animas County. Recent estimates of the annual revenue lost to the R-3 Hoehne School District were developed by the Las Animas County planner in conjunction with school district officials. Their estimate places the annual losses in tax income at $31,300 to the Hoehne District alone, with smaller losses in the R-82 Branson ($228) and R-98 Kim ($2338) School Districts. The Hoehne district occupies a large portion of central Las Animas County, and would lose about 27 percent of its tax base, reducing the value of each mill by roughly $1,000 creating a severe negative impact. The Hoehne School District has just voted an increased mill levy to accommodate the expense of new facilities. Nineteen years remain to retire the outstanding bonds at the rate of 4.20 mills for bond redemption, and 12.20 mills for bond interest (Personal communication, William Cordova, February 7, 1980).

The various formulas applied to arrive at the amounts for state and federal aid and support favor smaller, financially obstructed school districts, which could help reduce this potential impact. In order to eliminate this potentially serious impact, if this parcel is submitted for Congressional approval and acquisition, the request will include a special line item to retire the portion of the outstanding bond indebtedness attributable to the acreage that would be obtained.

Impact Summary

The overall economic impacts for the Pinon Canyon Parcel are similar to those discussed in Section 4.1.8. The exception is that the loss of tax revenue represents a severe impact on the Hoehne School district in Las Animas County. All other social and economic impacts are similar to the previous discussion due to the homogeneity of the region.

Land Use

The purchase of the Pinon Canyon Parcel would convert 257,236 acres (104,103 hectares) from grazing land to use as a remote training site. The carrying capacity for grazing at this site is estimated to be between 53 and 70 acres (21-28 hectares) per animal unit. In theory, at this rate it would be possible to graze between 3,750 and 5,701 cattle on the area under consideration for acquisition. In practice, the numbers have probably been in the mid-range of this estimate at any given time, due to varying management techniques among different ranchers (Personal communication, Bill Chandler, F.H.A., February 19, 1980).

The zoning for the Pinon Canyon Parcel and for most of the immediate vicinity is agricultural. The only potential interest in residential development at present is about 13,600 acres (5,504 hectares) called Las Animas Ranches, located east of Delhi south of the Otero County line, bordering the western edge of the parcel. Twenty percent of the 40-acre (16-hectare) lots have been sold but no improvements have been built on any of the lots, and zoning for the subdivision remains agricultural (Las Animas County Land Use Plan Element, 1978).

Las Animas County is sparsely populated and the growth rate is not expected to increase rapidly in the future. The county planners anticipate that most growth would locate in Trinidad and Aguilar near established communities and subdivisions and closer to the coal mines in the western portion of the county. No urban development is predicted for any areas contiguous to the Pinon Parcel. No expansion is anticipated in the small communities along U.S. Highway 350, which include Model, Tyrone, Thatcher, Houghton, and Delhi. Therefore, use of this parcel for military training would not create conflicts with existing or anticipated Las Animas County development.

Along the northern boundary of the parcel is the Comanche National Grassland in Otero County. There are no plans to use the grassland, though parcel use may extend to the grassland boundary. It is not anticipated that the operation of the grassland would be adversely affected by acquisition of the Pinon Canyon Parcel.

Transportation Impacts

A study has been made of transportation access routes to the Pinon Canyon Parcel (U.S. Army, 1978). Two "most feasible" routes were identified, based on using I-25 from Fort Carson to Pueblo. From Pueblo, two choices were identified. The first follows U.S. 50 east through Pueblo and on to La Junta. From there, the serial would proceed south on U.S. 350 to the proposed cantonment site at Thatcher[1]. This routing is not favored due to slightly higher mileage and the significant impact on several thousand residents of the many small communities along U.S. 50, including parts of Pueblo, Vineland, Avondale, Fowler, Manzanola, Rocky Ford, Swink and La Junta. Slightly over 100 miles (161 kilometers) of the distance by this route would be on two-lane, undivided highway, which would create traffic disruption and increase safety hazards.

The second route considered uses I-25 from Fort Carson to Trinidad, a distance of about 115 miles (185 kilometers), then turns north on U.S. Highway 350 to Thatcher. This route involves only about 38 miles (61 kilometers) of two-lane, undivided highway, much of which carries relatively low average traffic volume. Average daily traffic counts on U.S. 350 near Thatcher in 1976 were 420, while I-25 had 4,350 according to the Las Animas County Transportation Plan. If it were initiated today, this

[1] The first cantonment site proposed for Pinon was to be located near Houghton where there is a rail siding and road access across the pipeline road into the parcel. It was changed to Thatcher when the preferred boundary was established at Highway 350 at that point. There is also a rail siding near Thatcher.

route would have severe negative impacts on Trinidad with the additional traffic movement through the city. However, the Colorado Division of Highways District 2 Engineer's Office lists a bypass from I-25 to U.S. Highway 350 as a high priority in construction requirements. Army acquisition of this parcel could advance bypass construction and remove the impact to Trinidad residents (Personal communication, H. W. Harris, February 6, 1980).

U.S. Highway 350 is in need of at least thorough resurfacing with reconstruction required in some places. Upgrading could occur on a one time basis for the portion used to access the site. Some additional federal money may be available for future maintenance, if convoy use is found to be having an "unusual" impact on highway conditions.

The impact on rail transportation involves two railroad companies. The Denver, Rio Grande and Western (DRGW) and the Atchison, Topeka and Santa Fe (ATSF). Trains loaded at Fort Carson on the ATSF spurline would move to La Junta and then southwest to Thatcher. Trains loaded on the DRGW line would move south to Trinidad, change to the ATSF mainline and proceed northeast to Thatcher on the ATSF. The latter route seems to be preferred, though the Army would have to execute agreements with the railroads for freight service, and to avoid possible conflicts with increasing coal train traffic. Two 85-car trains would be required to move needed tracked equipment to the parcel for training. About six hours would be required enroute, after loading, to move a train from Fort Carson to Thatcher.

General impacts on air transportation have been described in Section 4.1.8. The impact on any existing air transport aspects would be negligible for the Pinon Canyon Parcel since no Terminal Control Area airspace would be affected by activities at this parcel.

<u>Energy Use - Impacts and Mitigation</u>

The consumption of energy fuels would comprise an irretrievable commitment of resources. The chosen route to reach the parcel would be the shortest of the two highway choices, and the decision to use rail transport instead of trucking the tracked vehicles would provide another means of saving fuel. The discussion of training fuel requirements and potential impacts to local supplies in Section 4.1.8 is applicable to this site.

4.2.9 Cultural Resources

The same type of archaeological and recent historical cultural resources which have been described in Section 4.1.9 are present in the area of the Pinon Canyon Parcel. The same archaic and more recent Indian culture groups occupied canyons throughout southeastern Colorado, and the Memorandum of Understanding (Appendix I) between the Army and the State Historic Preservation Officer outlines the proposed 100 percent survey and other protection measures. The Army has indicated that areas such as the Red Rocks Canyon and Purgatoire River Canyon would be designated off limits for military training exercises.

It is not anticipated that the recent historic sites or early exploration trails on the Pinon Canyon Parcel would conflict with military use of the parcel; this projected impact would be negligible. Over 60,000 acres (24,282 hectares) including Red Rocks Canyon and the Valley of the Purgatoire River has been recommended by the Heritage Conservation and Recreation Service as a National Natural Landmark. Areas such as the Purgatoire River and Red Rocks Canyon, which have limited utility for maneuvers, are not planned for acquisition by the Army (see Section 2.6.1). If the land in the canyons is acquired, however, the canyon areas would be fenced off and kept as set-aside areas, buffer zones and game protection areas. Areas within the canyons would not be affected by military use. Although military training would not occur in the major canyons, military use of the remaining parts of Unit D within the proposed National Natural Landmark would probably preclude its use as a Landmark. The impact of military training would therefore be severe. If the Red Rocks and Purgatoire areas are designated as a Natural National Landmark, the removal of available training land outside the canyons from Unit D would constitute an extreme impact upon availability of land in Unit D for military use.

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Mantelli, Edward L. & Charlotte K.
Marshall, Andrew
Martex Association
Martin, Cletus
Martin, Donald R.
Martin, Jerry
Martin, Mike & Mikki
Martinez, Manuel & Vivianita
Martinez, Margarito S. & Carmelita
Martinez, Ronnie
*Mascarenas, Ernest C.
Massarotti, Tony
Matern, Conrad B.
Maurello, Josephine
Mayer, Edna I.
Mayer, Madlyn R.
Mayer Vivian
Mayfield, Bill
Mayhan, Johnnie
*Mazza, Rudy
McCall, Elizabeth R.
*McCall, Michael A.
*McCarn, Dan W.
*McCarthy, Joseph & Mary
McDivitt, Michael W.
McElroy, Alred M. & Juanita J.
McFadden, Mary K.
*McGallard, Mack
*McGinn, John R.
McGuire, Jada M.
McIntyre, Albert
McKinley, Homer & Mabel
McKinney, Kenneth C.
McNeish, George R.
McPhanl, Evander
McVey, Lou

McWilliams Jr., Wm. F.
Medley, J. N.
Meek, William H.
Meinema, Abner J.
Melaik, Hattie B.
Melander, Dan J.
Merson, Harold
Midland Mortgage Co.
Mihelich, Rosie
Miler, Tom
*Miles, Donald L.
Miles, James
Miles, Lavora
Milinazzo, Domenic
Miller, Florence
Miller, Lonnie
Miller, Lee B.
Miller, Lorena S.
Miller, Richard F.
*Mincic, Charles
Mincic, Robert
Minick, Robert E. & Leona P.
Mitchell, Etta L.
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Model Land Irrigation Co.
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Moore, Cornelia
Moore, Hattie J.
Morey, Dale A. & Thelma
Morris, Margaret I.
Morris, Paul E.
Morrow, Alma
Morse, Vinita
Mottaz, Mabel Rollins
*Mounsey, C. J.
Munsell, Howard W.
Murry, Jerry R. & C.L.
*Muschetti, Ann M., et. al
National Audubon Society
National Wildlife Federation
Naumann, Gail K. & Violet M.
Nelson, John M. (Estate)
Nelson, Linda J.
Neumayr, Sharon
Newcomb, Jr., Marshall

Newkirk, et al, Catherine E.
*Newkirk, Mrs. Walter E.
Newkirk, K. E.
Nix, Don L. & Winona S.
*Nixon, Verna E. & Rolland
Noga, Frank & Shirley
Nolan, Albert
Norman, Harry
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Olsen, Bill
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Oreskovich, Joe
Orsland, Virginia
Osborn, Marshall K. & Sarah J.
Osnowitz, David
Otto, Mary
Page, Michael
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*Pantleo, Joe J. & Marjorie P.
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Pardee, Jerry A.
*Parsons, Bernard
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Poryear, Billy Joe Jr.
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Pullara, Marie G.
Pullara, Santo & Elleanor M.
Pullara, Phyllis Jeannine
Blank, Aubrey V. Pulley
Radiff, Maxwell G.
Gyurman Ranch, Inc.
*Red Rocks Ranch, Inc.
Red Top, Ltd.
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Reichwein, Frank V.
*Remple, Lois
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Reno, Bud
Renzelman, Roger
Reyes, Henry G.
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Riddell, Eva (Stockham)
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Riley, Leo E.
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River Canyon Ranch, Inc.
River Canyon Ranch
Rixse, Mel
Roberts, Julius
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Rooks & Sons, F. B.
Rose, Lorena
Rosenland, Bruce
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Ross, Robin L.
*Round, Ralph
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Rush, David M. (Estate)
Russell, Albert D.
Russell, Ted H.
Rust, Donald (School District 70)
Ryan, Roy L.
*Salardino, Steve J.
Salas, John A.
Salsbury, Hez A.
*Salzman, William
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Sandoval, Carlos (Estate)
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Savage, Gordon, Michael & Keven
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Schafrick, et al, Hugo & Elizabeth
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Schmidt, Mary A. Mills
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Scofield, Mrs. Morton Wells
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Seal Pharmacy, Inc.
Sears, Alice

Sample, Robert L. & Margaret
School District #82
Seiling, Lee T. & Mary J.
Selk, Letitia
Seme, Mr. & Mrs. Robert
Sessums, Roy T. & Pearl B.
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Shafroth, Frank H. & John F.
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Shaner, Clifford & Sara B.
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*Sharp, Dan G.
Sharp, Vernon E.
Sheckart, Lucille
*Sheetz, Mary Lynn
*Shehorn, Charles
Shelley, Richard A.
Sherar, Mrs. Corinne
Shoop, George
*Sierra Club
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Smith, Wilson
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Sneath, Ardeth
Snider, Elba W.
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Southern Colorado Livestock Association
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Speer, Raymond G.
Spencer, Tom

SPJ & SN
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Springer, Richard C.
Spangle, Wm. G. & Evelyn C.
*Spurlock, James J.
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Stark, M.
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Stevenson, John
Steves, Susan L. & Mark K.
Stineman, Evan C., Jr. & Eileen
Stockton, Gladys
*Straub, Edward W. & Sharon K.
*Stritzel, Mary Korach
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Stroh, Dave
*Stroh, Jack
Stuckey, Curtice A.
Suazo, Sadie V.
Swan, Donald L. & Elizabeth
Swan, Tristram R. & Carolyn
*Sweet, Jerry & Janet
Swift, Arnold & Jand
Tabot, Darold R.
Tagliatela, Louis & Marilou
Tatman, E. B.
Taylor, Myron L. & Alta M.
Teed, R. H.
Terry, Joe
*Thach, William M. & Annette
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Torres, Delia
Torres, Emilio
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Torres, Lloyd & Carmen
Torres, Max
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Treat, Lawrence E.
Treat, Rolland D.
Treat, Archie H.
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Trent, Doyle
Trinchera Cattle, Co., Inc.
Trinidad City Government
  City Manager, Ted Ryan
  May John Rino
Turner, Wilton & Shirley
Twyman, Lucille
Tyree, Thomas A. & Brian E.
United States Government
  Department of Defense
    Department of the Army COE (2)
    U.S. Air Force
    Office of Economic Adjustment
  Department of Agriculture (2)
    Agricultural Research Service
    U.S. Forest Service (3)
    Soil Conservation Service (5)
  Department of Commerce (3)
    Economic Development Administration
    National Bureau of Standards
  Department of Energy (5)
  Department of Health, Education & Welfare
  Department of Housing & Urban Development
  *Department of the Interior (20)
    Advisory Council on Historic Preservation
    Bureau of Land Management (2)
    Bureau of Reclamation
    *Fish & Wildlife Service (2)
    Geological Survey (2)
    Heritage Conservation & Recreation Service (2)
  Department of Labor (2)
  Department of Transportation (7)
    Federal Aviation Administration
    Federal Railroad Administration
  *Environmental Protection Agency (11)
  House Appropriations Committee
  House Armed Services Committee
  National Aeronautics & Space Administration
  Nuclear Regulatory Commission
  Senate Appropriations Committee
  Senate Armed Services Committee
  Water Resources Council

U.S. Senate & House (Colorado's
Delegation to the 96th Congress)
Senator Gary Hart
Senator Wm. Armstrong
Representative Schroeder
Representative Wirth
Representative Kogovsek
Representative Johnson
Representative E. Dela Garza
Represntative Kramer
Untiedt, E.G.
Utt, James A.
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Van Fleet, Rose & Wayne
*Van Camp, M.D., Wesley
*Van Dusen, Aurine & Donald
Van Dyne, William Harry
Van Matre, George & Lucy
*Vaughan, Carol & R. L.
Vayhinger, Jack
Veach, George
Veltri, Joe A.
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Vucetich, John
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Wagner, Mark
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Walker, Cleola Faye & Leta Bell Cain
Walker, Larry
Wallace, Frank
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Warren, Jim L.
*Watson, William R.
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Webb, Jean
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*Wells, Gerald A.
Welte, Joseph C.
Welte, Thomas R.
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Westworld

Walsenburg City Government
Mayor Leo Maes
White, Elmer P.
Wientge, Alice Jones
*Wigton, Chester M.
*Wigton, M.D., John R.
Wiley, Roy B.
Wilkinson, Charles M. Jr. & Josephine
Willet, Elizbeth W.
*Williams, Bill D. & Alberta N.
*Williams, E.Ed.
Williams, John E. & Brigitte
*Williams, Robert L.
Williams, Rose
Willis, Harry R.
Wilson, Berl A.
Wilson, George W.
Wilson, Jeanette R.
*Wilson, Jr., Keith
Wilshire, M. L.
Wilson, Raymond W.
Winford, Jerry
Winn, J. High
Winter, Rita Sue
*Winters, Donald
Wisner, Harold & Janet
Woodyard, Bess F.
Woodyard, Florence
Wooten, Herman
Wooten, Betty I.
*Wooten, Steve & J.
*Wolther, Mrs. Joan
*Wright-Ingraham Institute
Wyatt, Alden R. & Mary E.
Yaeger, Mrs. John J.
Yeckel, Carl L.
Young, Edward W. & Mary L.
*Young, Robert N.
Youngren Thompson Cattle Co.
Zaccacdi, Mary
*Zbacnik, Joseph A. & Rose A.
Zimmerman, Adrian J. & Josephine A. Downes
Zinsser, Mrs. Elizabeth
Zwick, Steven
*Hensley, Frank
*Marincich, Frank, Mrs.
*Ridennoure, Jerry L.

*Designates parties participating in scoping process.

7.0 REFERENCES, GLOSSARY AND INDEX

7.1 REFERENCES

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7.2 GLOSSARY

Acre-foot (ac-ft, acre-ft) - The quantity of water required to cover 1 acre to a depth of 1 foot, equivalent to 43,560 cubic feet or about 326,000 gallons or 1,233 cubic meters.

Active Headcuts - Erosion by gullying in nearly vertical cuts in the upstream portion of defined stream channels. Downcutting occurs toward the water source.

Air Quality Control Region (AQCR) - Designated geographical regions which are used in determining regional air quality.

Aquifer - A geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs.

ARTEP (Army training and evaluation program) - A means of evaluating a unit's proficiency for battle through a series of battle simulated missions. Pertains to a battalion in the strictest sense of the term, but often used in referral to company through division evaluations as well.

ATLAM - Army training land analysis model. Used in defining the training land area needs in terms of weaponry and necessary mission-exercises.

Background Concentration - The concentration of a pollutant resulting from purely natural sources.

Baseline Concentration - The sum of the pollutant concentrations from man-made sources and natural sources. Normally the baseline concentration applies to a small area like a county.

Battalion (Btn) - Operational unit of mechanized military force composed of about 900 personnel of three or more companies. Battalions may be specialized, therefore equipment composition and number of staff may vary.

Bed material - The unconsolidated material of which a streambed, lake, pond, reservoir, or estuary bottom is composed.

Biochemical oxygen demand (BOD) - The amount of oxygen required by bacteria while stabilizing decomposable organic matter under aerobic conditions.

Bivouac - Temporary encampment, associated with field maneuvers, moved often in conjunction with the maneuvering force.

Bottom material - See Bed material.

Brigade (Bde) - Military unit of about 5,000 personnel, usually formed by three battalions and a "brigade slice" or support unit.

Brigade Exercise - Field exercise using a full brigade in order to increase the unit's battle proficiency.

Buffer Zones - Designated neutral areas which act as additional protection for important areas by separating conflicting forces. In the sense used here, to protect an area from the effects of military training.

Calcareous Soil - A soil containing enough calcium carbonate (commonly with magenesium carbonate) to effervesce (fizz) visibily when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate. Non-calcareous soil lacks enough calcium carbonate to react to cold dilute hydrochloric acid.

Cantonment - Group of permanent structures for housing troops.

Carrying Capacity - An estimate of a land area's ability to support use.

Chiseling - Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface. A form of emergency tillage to control soil blowing.

Climax - the stable state of a plant community; culmination of a series of plant community changes in response to environmental factors until a balance between the two is reached.

Company - A military unit consisting of a headquarter and two or more platoons; about 120 - 130 troops normally composed of four platoons.

Control - Designates a feature downstream from the gage that determines the stage-discharge relation at the gage. This feature may be a natural constriction of the channel, an artificial structure, or a uniform cross section over a long reach of the channel.

Cover - The amount of ground surface protected by rock fragments, litter or vegetation. Estimated by measuring the surface of the ground obscured by these materials when viewed from directly overhead.

Cross Dikes - Bank of earth of other material positioned across a slope to retard surface erosion.

CDMQC model - An air quality dispersion computer model used to estimate long-term average concentrations.

Cubic foot per second (cfs, ft^3/s) - The rate of discharge representing a volume of 1 cubic foot passing a given point during 1 second, and is equivalent to approximately 7.48 gallons per second, 448.8 gallons per minute, or 0.02832 cubic meters per second.

Decibel (dB) - A unit for expressing the relative intensity of sounds on a scale from zero for the average least perceptible sound to about 130 for the average pain threshold level.

Delay - Part of an ARTEP or field training exercise; an organized withdrawal from a battle engagement. The delay can either be opposed or unopposed, and requires the largest land area of all the ARTEP or FTX missions.

Desert - Land in a climate zone having a precipitation:evaporation index of less than .20 (Weaver & Clements 1938).

Discharge - The volume of water (or more broadly, volume of fluid plus suspended sediment), that passes a given point within a given period of time.

Dissolved - Refers to the amount of a substance present in true chemical solution. In practice, however, the term includes all forms of the substance that will pass through a 0.45-micrometer membrane filter, and thus may include some very small (coiloidal) suspended particles. Analyses are performed on filtered samples.

Diversion channel - an open channel constructed to divert runoff from its natural course.

Diversion (or diversion terrace) - A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Division - A military unit usually made up of three to five battle groups (brigades), although this is variable. The 4th Infantry (Mech) Division at Ft. Carson includes about 16,500 personnel of three battalions and headquarters support staff.

Drainage area of a stream at a specified location - That area, measured in a horizontal plane, enclosed by a topographic divide from which direct surface runoff from precipitation normally drains by gravity into the stream above the specified point. Figures of drainage area given herein include all closed basins, or noncontributing areas, within the area unless otherwise noted.

Effective Silt Content - The silt content of the soil excluding the natural dry soil aggregates; see silt content.

Emission Factor - A number that is used to calculate the emission inventory. For example a car traveling 30 mph emits 1.0 grams of carbon monoxide per mile. The 1.0 is referred to as the emission factor.

Emission Inventory - A process by which all the emissions from a given activity are calculated in order to assess the magnitude of the emissions. The result of the emission inventory are later used in calculating ambient concentration.

Emission Rate - A number used in an air quality dispersion model to represent the rate at which a polluant is being released. Normally has dimensions of grams per second.

Emulsifiers - A chemical agent promoting the formation of a surface bond. In this sense used to bond the upper soil surface to prevent erosion.

Endangered Species - A species which appears to be near extinction over all or part of its range.

EPA (Environmental Protection Agency) - An independent Federal agency established in 1973 to set guidelines regarding environmental impact statements.

Ephemeral Watercourses - Drainage systems in which surface flow is evident only part of the year, usually in spring; also known as intermittent.

Erosion - The wearing away of the land surface by running water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Eutrophic - Rich in dissolved nutrients and shallow or seasonally deficient in oxygen. Associated with stagnant water bodies.

Fecal coliform bacteria - Bacteria that are present in the intestine or feces of warmblooded animals. They are often used as indicators of the sanitary quality of the water. In the laboratory they are defined as all organisms which produce blue colonies within 24 hours when incubated at 44.5°C $\pm$ 0.2°C on M-FC medium (nutrient medium for bacterial growth). Their concentrations are expressed as number of colonies per 100 ml of sample.

Field Training Exercise (FTX) - Maneuvers aimed at increasing the battle proficiency of a unit. May simulate a battle situation or mission.

Frequency - See Recurrence interval.

Gage height (G.H.) - The water-surface elevation referred to some arbitrary gage datum. Gage height is often used interchangeably with the more general term "stage," although gage height is more appropriate when used with a reading on a page.

Gaging station - A particular site on a stream, canal, lake, or reservoir where systematic observations of gage height or discharge are obtained. When used in connection with a discharge record, the term is applied only to those gaging stations where a continuous record of discharge is computed.

Gravel - Rock fragments larger than sand particles and smaller than cobbles. General range in diameter for gravel is between 2 mm and 75 mm (.08 in. and 3 in.).

Gully - A steep sided small ravine formed when soil is removed by running water in a defined channel.

Hardness of water - The physical-chemical characteristic that is commonly recognized by the increased quantity of soap required to produce lather. It is attributable to the presence of alkaline earths (principally calcium and magnesium) and is expressed as equivalent calcium carbonate ($CaCO_3$).

Impact - The force or effect of an action of one thing on another. Used here in the context of effects of particular land use (military training needs) on environmental parameters.

Interseeding - Introducing seed into existing plant cover by means of removing competitive growth in a strip by a special plow disc or blade.

Invaders - Plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally invader plants become prominent following disturbance of the surface.

Irrigation ditch - An open channel designed to convey water supplies to areas to be irrigated.

Joint Frequency Distribution - A summary of wind speed and direction data which also incorporates the Pasquill stability classes. Used as input for the CDMQC model to describe average meteorological conditions.

L Factor - Used in describing sound using a time period above a particular threshold; i.e., L 90 is the sound level exceeded 90 percent of the time during the measurement period.

Land Use Management Plan (LUMP) - A means of coordinating prospective land use in order to minimize impacts and thus maintain or enhance existing land use capabilities.

Lateral Dikes - Small mound or dam perpendicular to the slope used to curtail soil water erosion.

Loam - a soil textural name for soil material containing 7 to 27 percent clay, 28 to 50 percent silt and less than 52 percent sand.

LURS (Land Use Resource Study) - in investigation of existing or potential resources of an area; resources here meaning both biotic carrying capacity and inherent land use capability.

Major Trail - With vehicular use, a trail in which wheel tracks are clear of vegetation for sizeable distances, and the center portions of trail support only reduced stands of disturbed vegetation.

Medium Textured Soils - Soils containing more than 18 percent and less than 35 percent clay; includes loam, clay loam, sandy clay, silty clay loam and silt loam textures.

Micrograms per liter (UG/L, µg/l) - A unit expressing the concentration of chemical constituents in solution as mass (micrograms) of solute per unti volume (liter) of water. One thousand micrograms per liter is equivalent to one milligram per liter.

Microrelief - Small-scale, local differences in topography, including mounds, rises or depressions that are only a few feet in diameter and up to six feet in height.

Milligrams per liter (MG/L, mg/l) - A unit for expressing the concentration of chemical constituents in solution. Milligrams per liter represent the mass of solute per unit volume (liter) of water. Concentration of suspended sediment also is expressed in mg/l, and is based on the mass of sediment per liter of water-sediment mixture.

Minor Trail - With vehicular use, unvegetated wheel tracks are discontinuous and adjacent vegetation is similar to undisturbed areas.

Model Dome Helium Field - A previously developed oil and gas field on the Pinon Parcel which currently is not considered economically viable.

Moderately developed - Soils in which alteration from parent material is noticeable. In calcareous parent materials, surface layers are noncalcareous and dark colored showing organic matter accumulation; usually clays and carbonates have been moved downward with accumulations in lower horizons.

National Ambient Air Quality Standards (NAAQS) - A set of standards set forth by the Federal government to protect the health of the general public.

Natural Plant Community - An assemblage of species occurring in response to a habitat or natural environment and not as a result of man's influence.

Partial-record station - A particular site where limited streamflow data are collected systematically over a period of years for use in hydrologic analyses.

Particle size - The diameter, in millimeters (mm), of suspended sediment or bed material determined either by sieve or sedimentation methods. Sedimentation methods (pipet, bottom-withdrawal tube, visual-accumulation tube) determine fall diameter of particles in either distilled water (chemically dispersed) or in native water (the river water at the time and point of sampling).

Particulate Emissions - Separated, dispersed substances which are discharged into the air.

Pasquill Stability Classes - A method development by Pasquill for classifying atmospheric stability. The stability is a measure of how fast or effectively the atmosphere can disperse polluants.

Picocurie (PC, pCi) - One trillionth (1×10^{-12}) of the amount of radioactivity represented by a curie (Ci). A curie is the amount of radioactivity that yields 3.7×10^{10} radioactive disintegrations per second. A picocurie yields 2.22 dpm (disintegrations per minute).

Pitter-Seeding - The process of making shallow pits on the soil surface at regular intervals by a drill designed to plant seeds in the pits at a specific rate and depth.

Potential Plant Community - A theoretical community type of a given habitat based on successional progression toward a climax community that has occurred in similar habitats.

Range Condition - Condition classes generally reconized are; Excellent, Good, Fair and Poor. The classification is based on the percentage of original or climax vegetation on the site as compared to what should grow on it if management is permitted.

Range Site - Classification used to indicate ability of land to support grazing and its current condition in relation to potential in terms of production.

Receptor - A term used in air quality dispersion modeling to denote a place where the ambient concentration from a source is calculated.

Recurrence interval - The average interval of time within which the discharge will be equaled or exceeded once.

Reserve Units - Troops of the Army reserve including the National Guard which supplement the strength of the regular army units.

Residual Cover - The amount of cover remaining on the soil surface where the vegetative cover has been totally destroyed by disturbance.

Rip-rap - Sustaining wall of stable material (gravel, stones) on the embankment or slope to prevent soil erosion.

Secondary Trail - With vehicular use, a trail in which wheel tracks are clear of vegetation and the center portion of trail supports healthy vegetation similar to undisturbed areas.

Sediment - Solid material that originates mostly from soil or disintegrated rocks and is transported by, suspended in, or deposited from water; it includes chemical and biochemical precipitates and decomposed organic material, such as humus. The quantity, characteristics, and cause of the occurrence of sediment in streams are influenced by environmental factors. Some major factors are degree of slope, length of slope, soil characteristics, land usage, and quantity and intensity of precipitation.

Sediment Reduction Buffers - Natural or mechanical devices which reduce soil erosion and subsequent stream siltation.

Sedimentation basin - Any type of structure that provides for sediment accumulation.

Seed Dribbler - Device used in conjunction with other tillage operations to place seeds into or onto the ground.

Semi-arid - An environment barely having sufficient moisture to support agriculture. Often used in describing very dry climatic regions which have a higher precipitation:evaporation ratio than .20 which indicates desert conditions.

Serial Groups - Groups of vehicles moving as a unit on a highway or road; convoy.

Silt - As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Silt Content - The percentage of total fine soil material which when dispersed in water, is of silt size.

Soil Erodibility - The tendancy for soil to be removed by the force of water or wind movement, affected by physical properties of the soil such as texture, organic matter and aggregation and by the environment in which the soil occurs, including vegetative cover, rock and litter cover, type of vegetation, landscape position and climate.

Slope - The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Soil Development - The alteration of parent material (geologic material) by soil forming (weathering) processes. Includes the accumulation of organic matter and the movement of clay and/or carbonates downward in the soil profile.

Soil Puddling - Soil particle dispersal by combined action of water and compaction or stirring.

Soil-Range Mapping Units - Areas delineated in field mapping which have similar compositions of soils and range sites whenever they occur within a parcel (see Appendix C for mapping methodology).

Specific conductance - A measure of the ability of a water to conduct an electrical current and is expressed in micromhos per centimeter at 25°C. Because the specific conductance is related to the number and specific chemical types of ions in solution, it can be used for approximating the dissolved-solids content in the water. Commonly, the amount of dissolved solids (in milligrams per liter) is about 65 percent of the specific conductance (in micromhos per centimeter at 25°C). This relation is not constant from stream to stream or from well to well, and it may even vary in the same source with changes in the composition of the water.

Stratified - Arranged in strata, or layers. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Streamflow - The discharge that occurs in a natural channel. Although the term "discharge" can be applied to the flow of a canal, the word "streamflow" uniquely describes the discharge in a surface stream course. The term "streamflow" is more general than "runoff."

TDS (Total dissolved solids) - The amount of solutes, sediment or colloidal concentration in a stream or water body.

Tons per square mile per year - The quantity of a substance in solution or suspension in tons (0.9072 tonnes) that discharges from a unit area during a one-year period.

Total (as used in tables of chemical analyses) - Refers to the amount of a substance that is present both in solution and in suspension. Analyses are performed on representative samples of water-suspended sediment mixtures.

Tracked Vehicles - Vehicles such as tanks, armored personnel carriers, self-propelled weapons moving by tracks (circulatory metal belts).

TRADOC - Training and doctrine command.

Trail - A path denuded of vegetation by the movement of vehicles, animals or man across land surfaces.

Universal Soil Loss Equation - An equation developed to predict the sheet and rill erosion from agrcultural lands east of the Rocky Mountains, recently adapted for the Western U.S. It takes the form A = RKLSCP, where R is the rainfall factor, K is the soil erodibility factor, L is the length of the slopes, S is the percentage of slope, C is the percentage of vegetative or other cover, and P is the cropping or management practice being used. A is expressed in tons of soil lost per acre per year. See Appendix C for the methodology used in this analysis and a detailed description of the USLE.

Water year (Geological Survey) - The 12-month period, October 1 through September 30. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months. Thus, the year ending September 30, 1977, is called the "1977 water year."

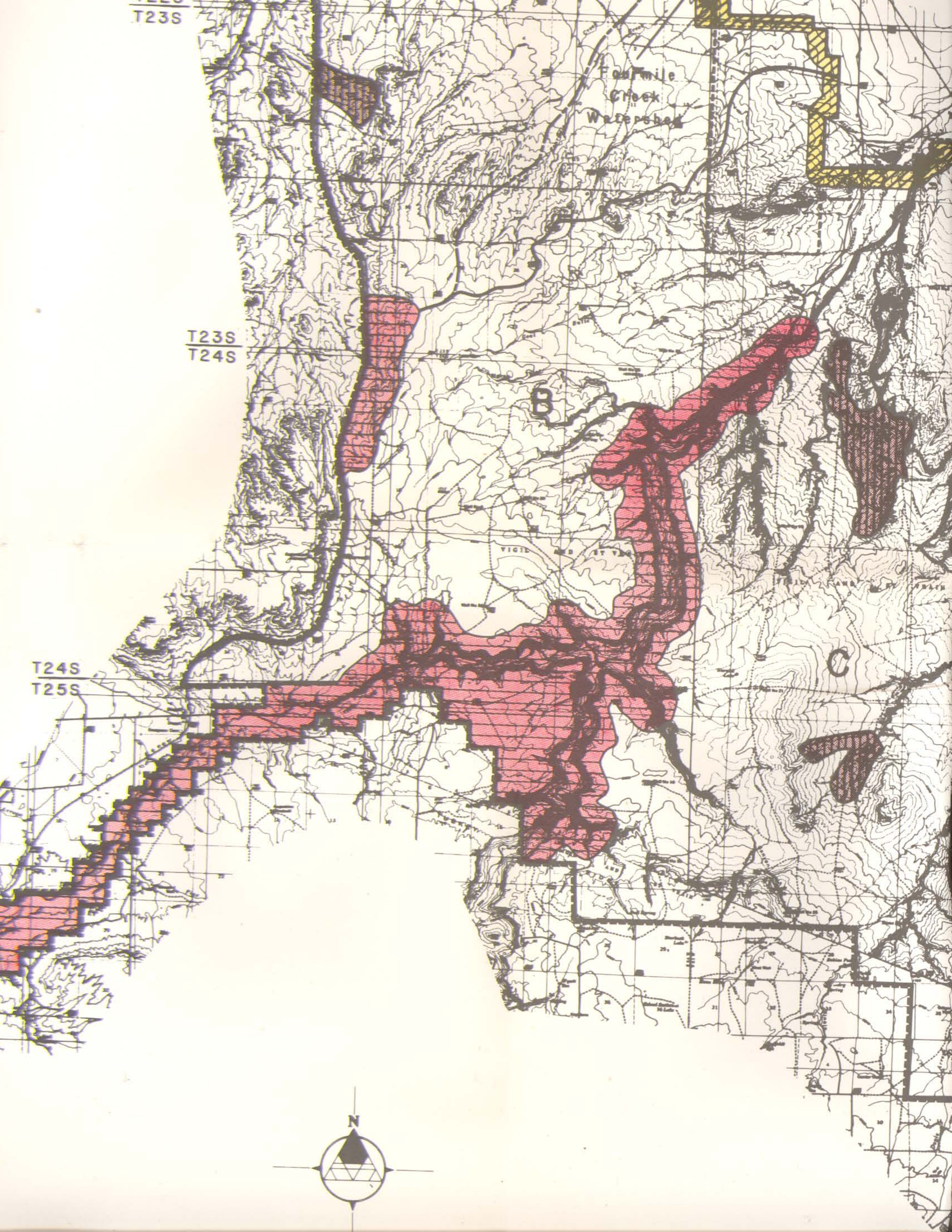
Weakly Developed - Soils in which little alteration in parent material has taken place. For example in calcareous parent materials, soils are commonly calcareous throughout and have minor accumulations of organic matter in the upper 1 - 2 inches (2.5 - 5 cm). Also called poorly developed soils.

Wheeled Vehicles - Mainly trucks and jeeps either two wheel or all-wheel drive used in military operations. An assortment of 1/2 ton, 3/4 ton pick-ups, vans, and semi-trailer trucks are attached to a unit for transportation and exercise uses.

Wildlife Protection Area - Area set aside from potentially damaging land use to protect wildlife species and habitat. May include fencing.

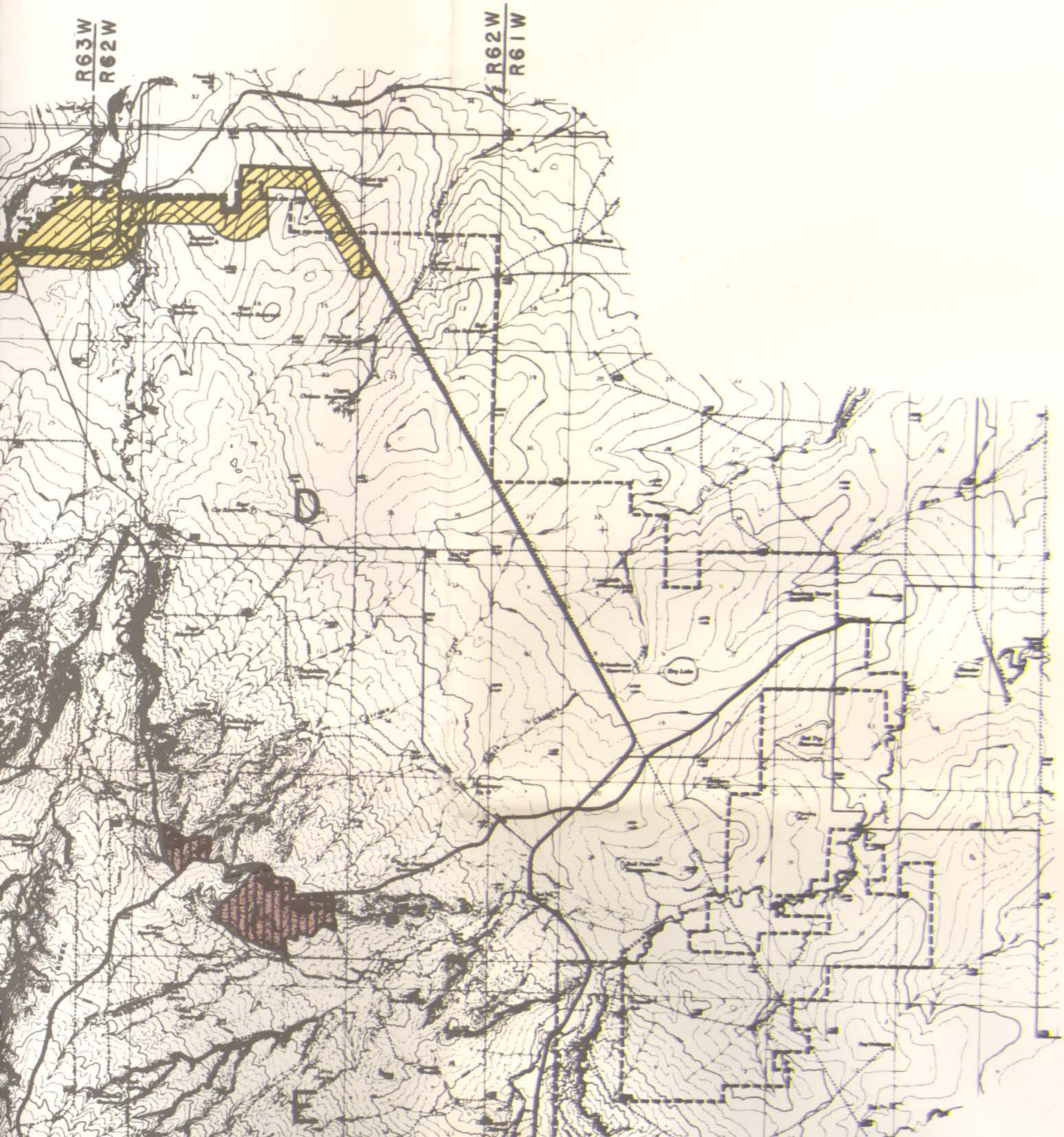
Wind Erosion Equation - An equation currently being researched by the Soil Conservation Service and Science and Education Administration, Agricultural Research. It takes the form E = IKCLV, where I is the soil erodibility, K is the soil ridge roughness factor, C is the climatic factor, L is the unsheltered distance travelled by the prevailing wind at a location and V is the vegetative cover. E is expressed in tons of soil lost per acre per year. The equation aids in determining management practice (K,L and V) which will be necessary to reduce the effect of natural conditions (I and C) on wind erosion losses.

7.3 INDEX


T23S
T23S
T24S
T24S
T25S
Fourmile
Creek
Watershed
B
C
N

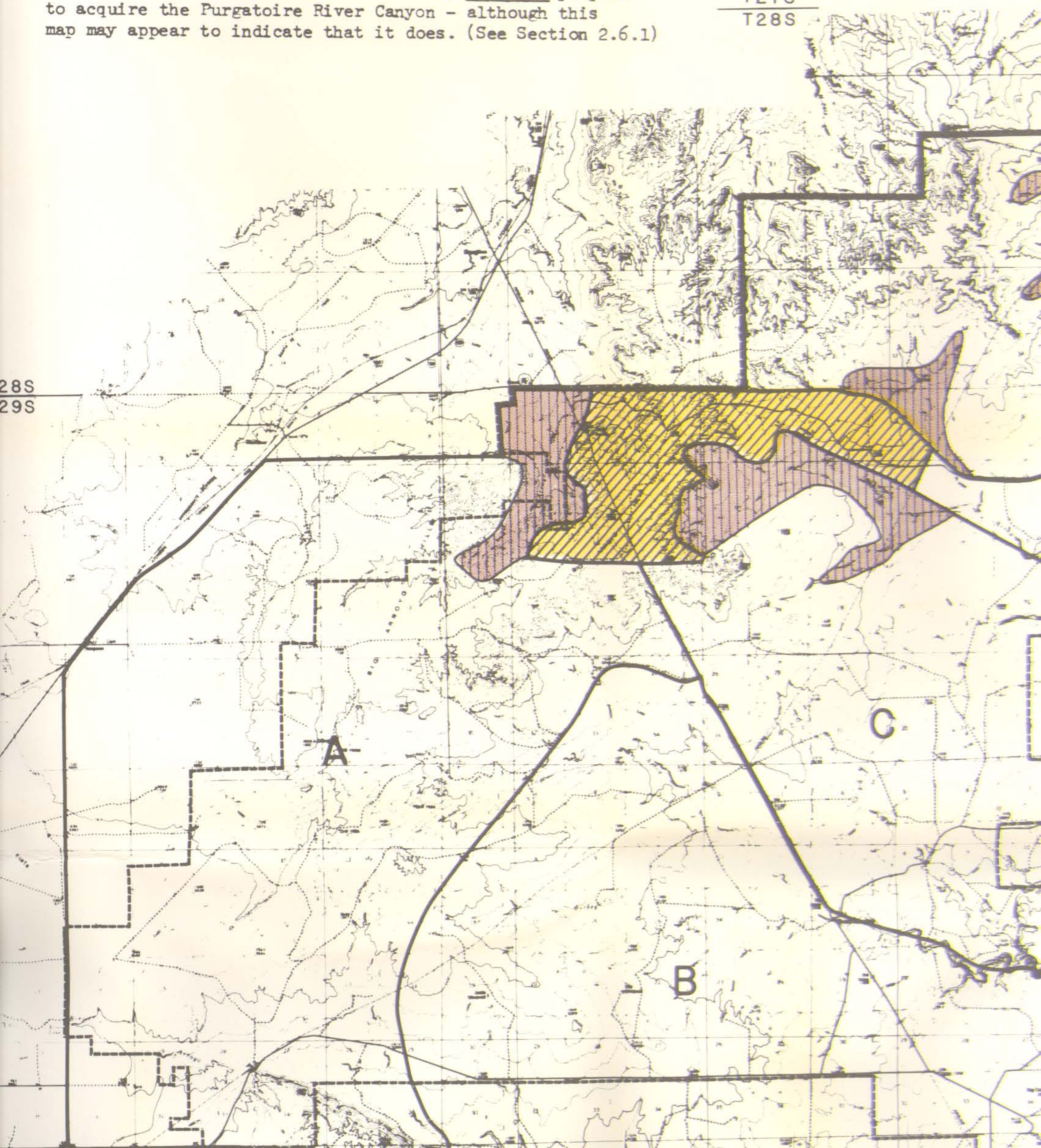
HUERFANO RIVER PARCEL BASE MA

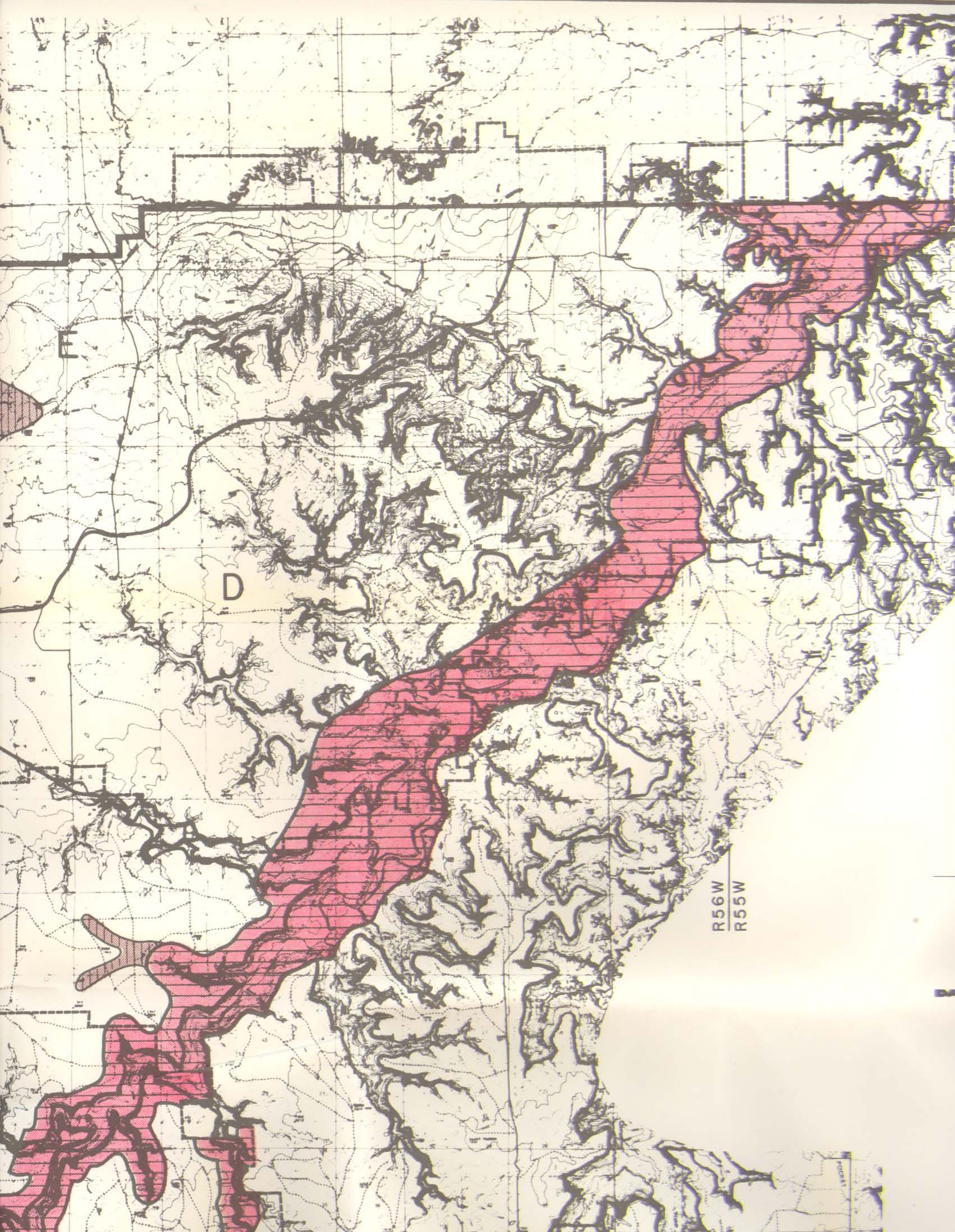
GEMENT UNIT A includes the Fourmile Creek
in the Optimum Use and Mission Intensive Scenarios.
Resource Protection Scenario, the Fourmile Creek
is included in MANAGEMENT UNIT B.

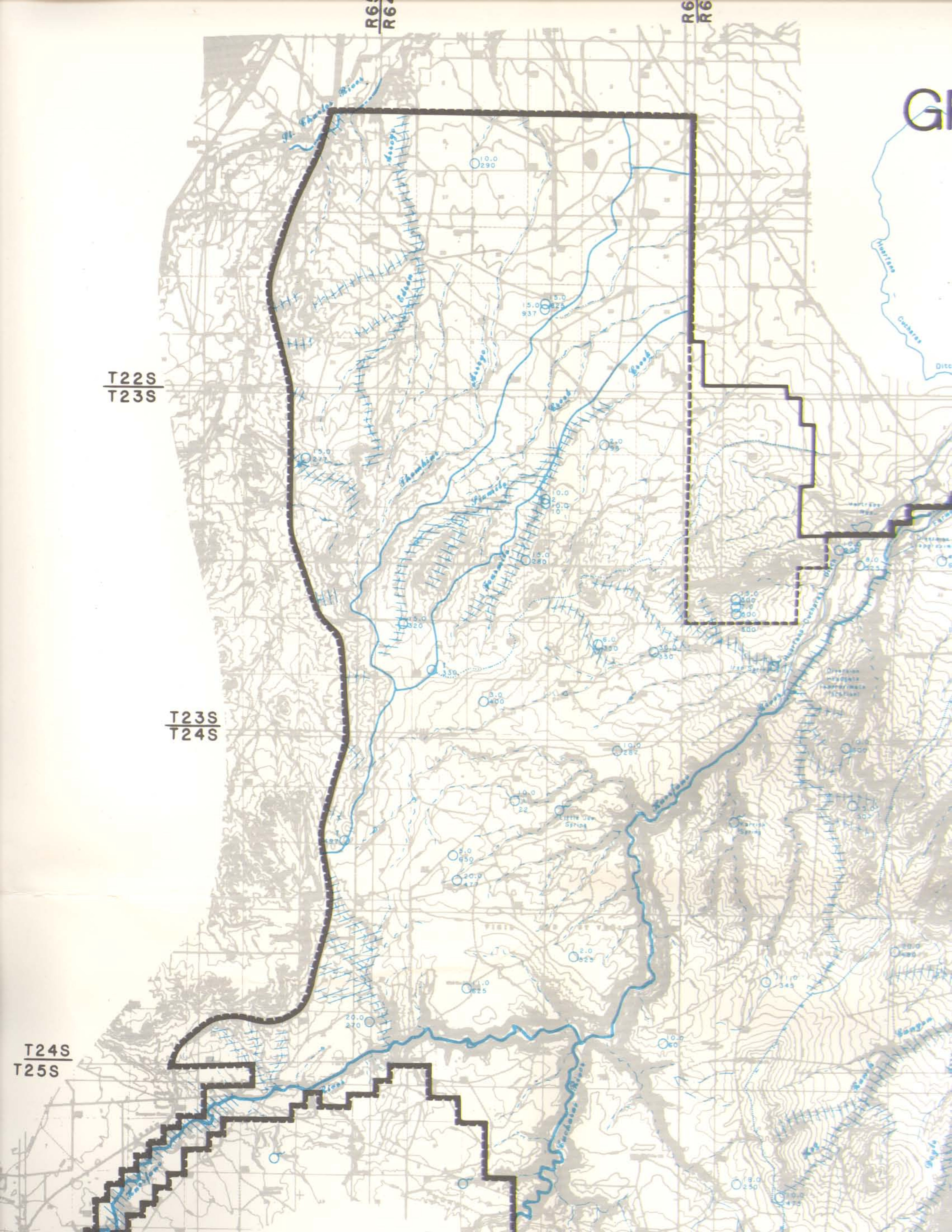


ION CANYON PARCEL BASE MAP

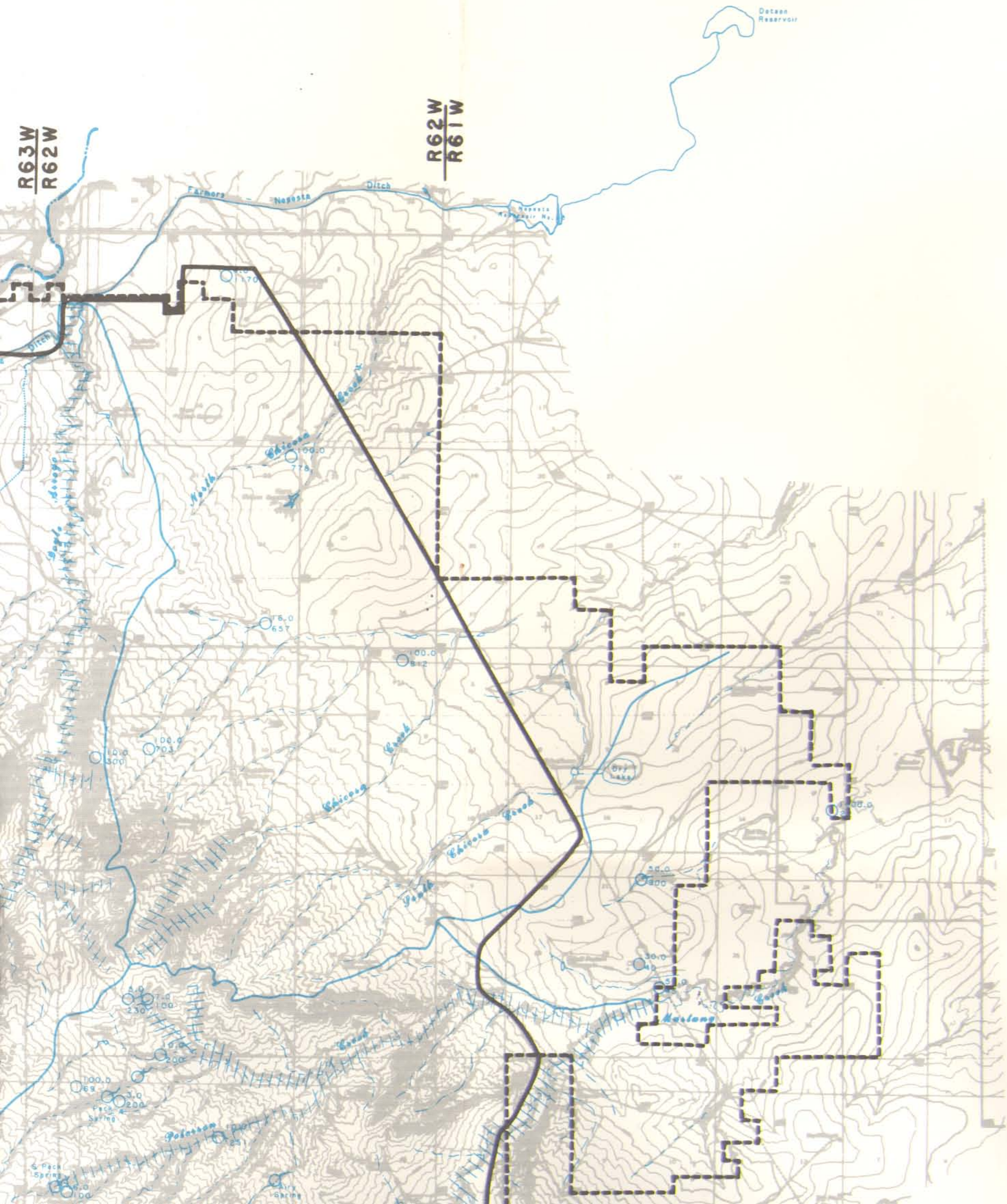
At this time, the Department of the Army does not propose to acquire the Purgatoire River Canyon - although this map may appear to indicate that it does. (See Section 2.6.1)




E
D
R56W
R55W


T22S
T23S
T23S
T24S
T24S
T25S

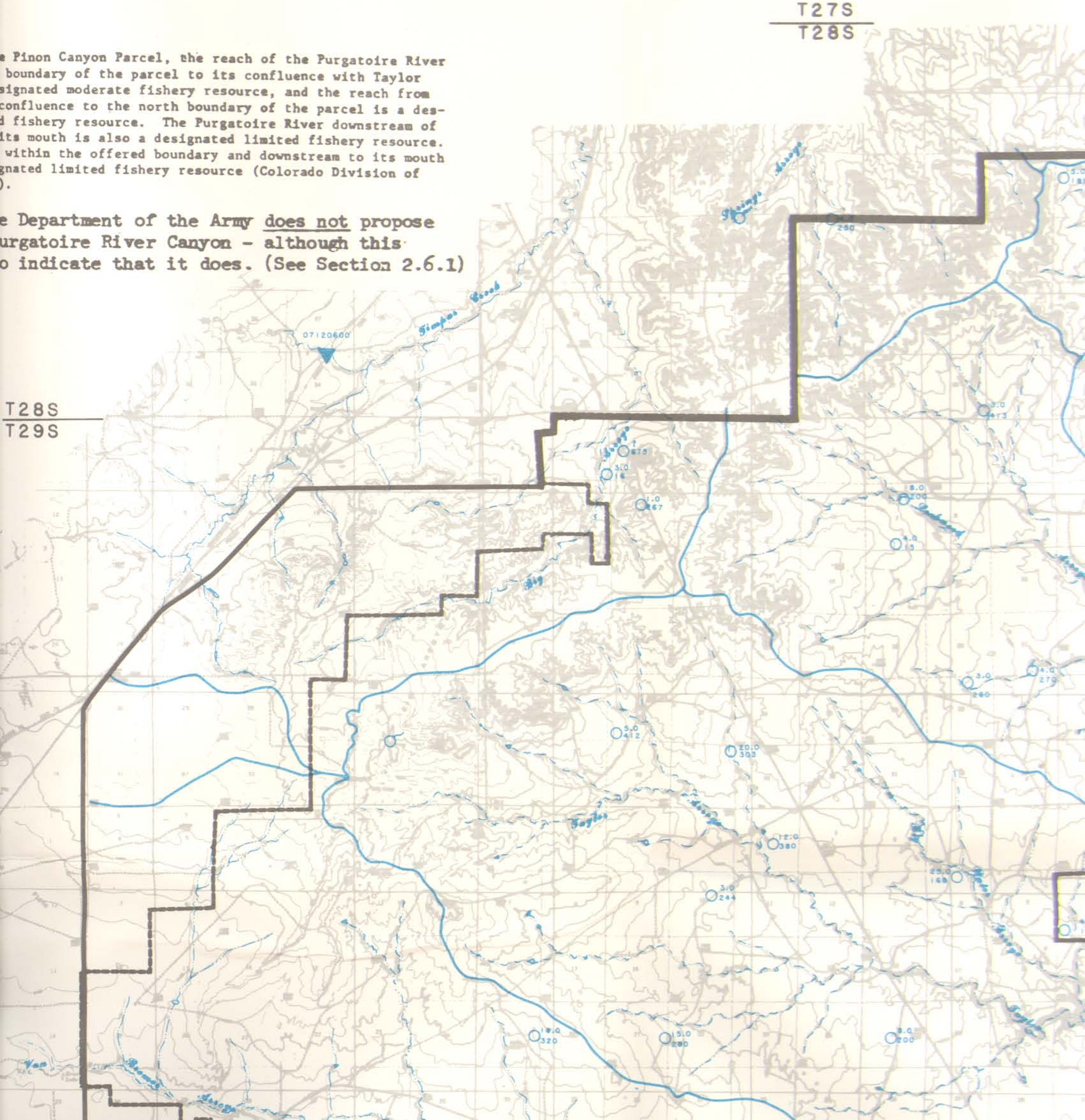
HUERFANO RIVER PARCEL GENERAL SURFACE AND OUND WATER HYDROLOGY MAP



PINON CANYON PARCEL
GENERAL SURFACE AND
UND WATER HYDROLOGY MAP

e Pinon Canyon Parcel, the reach of the Purgatoire River
boundary of the parcel to its confluence with Taylor
signated moderate fishery resource, and the reach from
confluence to the north boundary of the parcel is a des-
d fishery resource. The Purgatoire River downstream of
its mouth is also a designated limited fishery resource.
within the offered boundary and downstream to its mouth
gnated limited fishery resource (Colorado Division of
).

e Department of the Army does not propose
urgatoire River Canyon - although this
o indicate that it does. (See Section 2.6.1)



Sugarloaf Spring
07126400
Red Rock Canyon
Canyon
River
R56W
R55W