LANDS

Challenge

Sustaining Fort Carson's training areas is critical to the mission and to long-term viability of Fort Carson as a power projection platform. How can Fort Carson provide realistic training areas through environmental stewardship? How can Fort Carson continue to use its training lands while being a good neighbor to a growing community?

Key Considerations

- **Transformation** – As the Army transforms over the next 25 years, the systems and mission of Fort Carson are likely to change as well. More lethal systems that function at greater distances will need different types of areas for training. Land requirements for new systems and missions may have a profound impact on Fort Carson's sustainability.

- **Training Land Conditions** – Land conditions directly affect the ability of Fort Carson's units to conduct and sustain realistic readiness training and to protect and enhance ecosystem health. Environmental concerns include erosion, vegetation management, sediment movement, runoff, water quality, and wildlife habitat management. Sustaining the post's land in a high-quality condition may require that some land be used for purposes other than the primary mission—indefinite support of readiness training.

- **Noise** – Fort Carson is surrounded by an expanding Colorado Springs community (up 27.5 percent over the past 10 years). Close proximity of civilian lands generates infrequent noise complaints. Resolution of such complaints requires community education on the importance of Army training and the role of Fort Carson units in the Army's Strategic Plans. Common sense training plans support readiness requirements and alleviate some civilian nuisance concerns. Noise models should be incorporated into community and regional planning to ensure "smart growth."

- **Encroachment** – Fort Carson should continue to work with local communities to influence local land use management to minimize (1) impacts of adjacent community growth on readiness training and training land sustainment and (2) impacts that Army activities may have on adjacent communities. The lease or purchase of adjacent lands can expand species' habitats, reduce restrictions on training, and create buffers between Army activities and the desirable growth of surrounding communities. Realistic community zoning and real estate transactions should reflect and minimize the impacts of Fort Carson's training mission.

- **Water Quality** – Fort Carson must manage, repair, and sustain training lands to minimize training impacts on surface water and groundwater quality. This includes reducing sediment movement and removing munitions and metal contaminants from water sources.

- **Cultural Resources** – Fort Carson must manage, repair, and sustain training lands to minimize training impacts on cultural resources and to balance preservation and conservation with training requirements. The main restriction to training is digging within the boundaries of protected archaeological sites. Cultural resource staff must work closely with training staff, continually evaluating and protecting sites while supporting training requirements and priority work projects.

Importance to Fort Carson

Mission – Land for combat training and cantonment activities is vital to mission accomplishment and the survivability of soldiers. If the land degrades, the ability to train realistically also degrades. Personnel that use Fort Carson and the Piñon Canyon Maneuver Site include:

- 2,500 Department of the Army (DA) civilians
- 15,000 Active Duty Military personnel
- 12,000 Reserve and National Guard personnel

A total of 374,419 acres at Fort Carson and the Piñon Canyon Maneuver Site provide:

- 67 Firing Ranges
- 79 Training Areas
- Butts Army Airfield
- 2 Combat Assault (C-130H) Airstrips
- 16 Drop Zones
- Air Force Live-Fire Range

Quality of Life – An aesthetic installation with attractive, local landscaping enhances quality of life, promotes pride in the area's natural beauty, and attracts quality recruits to Fort Carson.

Costs

- In 2002, the estimated costs for training land maintenance and restoration, many of which will not be funded, include:
    - New Trees and Landscape Maintenance: $165,000
    - Wildfire Prevention: $20,000
    - Wetland Protection and Recovery: $95,000
    - Watershed Management: $765,000
    - Selenium Remediation: $74,000
    - Plant Materials Program: $25,000
    - Invasive Weeds Control: $100,000
    - ITAM/Range Maintenance Programs: $1,500,000
    - Wildlife/Endangered Species Management: $389,000

Environment and the Community – A community that sees the Installation caring for its lands will be more willing to support the continuation of activities and cooperate with the Installation when activities conflict. Ecosystems have no boundaries, so invasive weeds and other issues that affect Fort Carson and the Piñon Canyon Maneuver Site affect the surrounding communities. Therefore, cooperation is required to effectively care for the total ecosystem on the Installation and its major training areas.

LANDS

Introduction

Fort Carson's mission is to train, mobilize, sustain, and deploy combat-ready forces. Intense, realistic training is critical to maintaining the highest level of readiness for deployment to combat situations. To accomplish this mission, environmentally sound training sites, cantonment areas (administrative, virtual training, information systems, headquarters, vehicle repair facilities, etc.), downrange locations, and family housing areas are necessary. This section provides information on the various programs to conserve the lands on which all of these activities must take place: soil conservation, vegetation (noxious weeds, forestry, native grasslands, landscaping), wildfire management, and watersheds (including wetlands).

Background

Due to the dry climate and altitude, Fort Carson and the Piñon Canyon Maneuver Site (PCMS) need special care to maintain ecosystem viability. On the high-altitude prairies of Fort Carson and PCMS, the climate is dry, yet wet enough to grow specific and locally adapted plants. The delicate balance of plants, water, and soils on the land is required for sustainability of both the ecosystem and the military training mission. If vegetation is lost due to military maneuvers or other activities, erosion and soil loss will result.

Live-fire training is not allowed on the Piñon Canyon Maneuver Site, but many firing ranges are available downrange of the cantonment area on Fort Carson. Training area allocation and live-fire range scheduling are controlled by the G3; Directorate of Plans, Training and Mobilization; Range Control Office (G3, DPTM). After maneuvers, Directorate of Environmental Compliance and Management (DECAM) and Range Control personnel evaluate the areas to locate disturbed areas and determine appropriate remediation.

The Piñon Canyon Maneuver Site is the second largest Department of Defense training site within the United States, with 235,896 acres used for force-on-force mechanized brigade training. Fort Carson is also large, with 138,523 acres of wetlands, recreational sites, training areas, and cantonment areas (Figure 5.1). Hosting soldiers, families, civilian employees, military retirees, and contractors, the Fort Carson garrison is considered a small city (see inside cover for statistics). Maintaining soils, rangelands, forests, wetlands, and landscaping, while preventing wildfires and invasive weeds, are ongoing challenges.

Figure 5.1 – Some Land Uses at Fort Carson and the Piñon Canyon Maneuver Site*

Unit and Activity	Fort Carson	Piñon Canyon Maneuver Site
Number of Training Areas	56	23
Acres of Training Areas	82,000	220,000
Acres of Impact Areas	21,740	0
Recreation Acreage	2,268	0
Acres of Hunting and Nonconsumptive Wildlife Use**	All (seasonal)	All (seasonal)
Acres of Wetlands	1,076	4,776
Acres of Forest	40,000	65,730

*Not all acreage is categorized and some areas are covered under multiple uses.
** Recreational utilization/availability is dependent on military training.

In addition to the myriad of vehicles and equipment used for training, troops also must bivouac (camp out) just as they would in a war situation. Approximately one ton of trash per day is created by 500 troops in a bivouac field environment. Trash is temporarily collected before removal, using vehicles that could and should often be used for other mission-related purposes. In the cantonment area of the garrison, removal of trash is normally performed by contracted services.

The Integrated Training Area Management (ITAM) Program, which operates as a component of the Installation's Integrated Natural Resources Management Plan (INRMP) monitors and inventories the condition of training lands; provides education and awareness programs; rehabilitates and revegetates the land; and provides GIS capabilities. All of these activities integrate mission and natural resources programs. However, land management funding is limited and projects are prioritized.

Land management at Fort Carson and the Piñon Canyon Maneuver Site benefits the training mission by supporting the environment through vegetation and soil conservation, wildfire management, and watershed monitoring, among other activities. The Army Corps of Engineers Construction Engineering Research Laboratory conducted a Return On Investment study at Fort Carson to determine if land rehabilitation and management were cost effective for the Army. The study concluded that the benefits from land rehabilitation and management included cost savings in addition to environmental and training benefits. The study may be ordered at http://www.cecer.army.mil/td/tips/pub/details.cfm?PUBID=1245&LAB=1.

Activities and Impacts

Many training activities affect the health of the land. Training can extract a heavy toll on lands; movement to the range area and training activities disturb plants and soils. The Army studies impacts and takes many precautions, which include filing an After Action Report following every major training activity of Battalion strength or larger, implementing prescribed burning before training, detonating unexploded ordnance, and inspecting the land after training activities to ensure that excessive damage was not done. Figure 5.2 illustrates some of the major activities that impact the land during training maneuvers.

Figure 5.2 – Military Land Use: Activities and Impacts

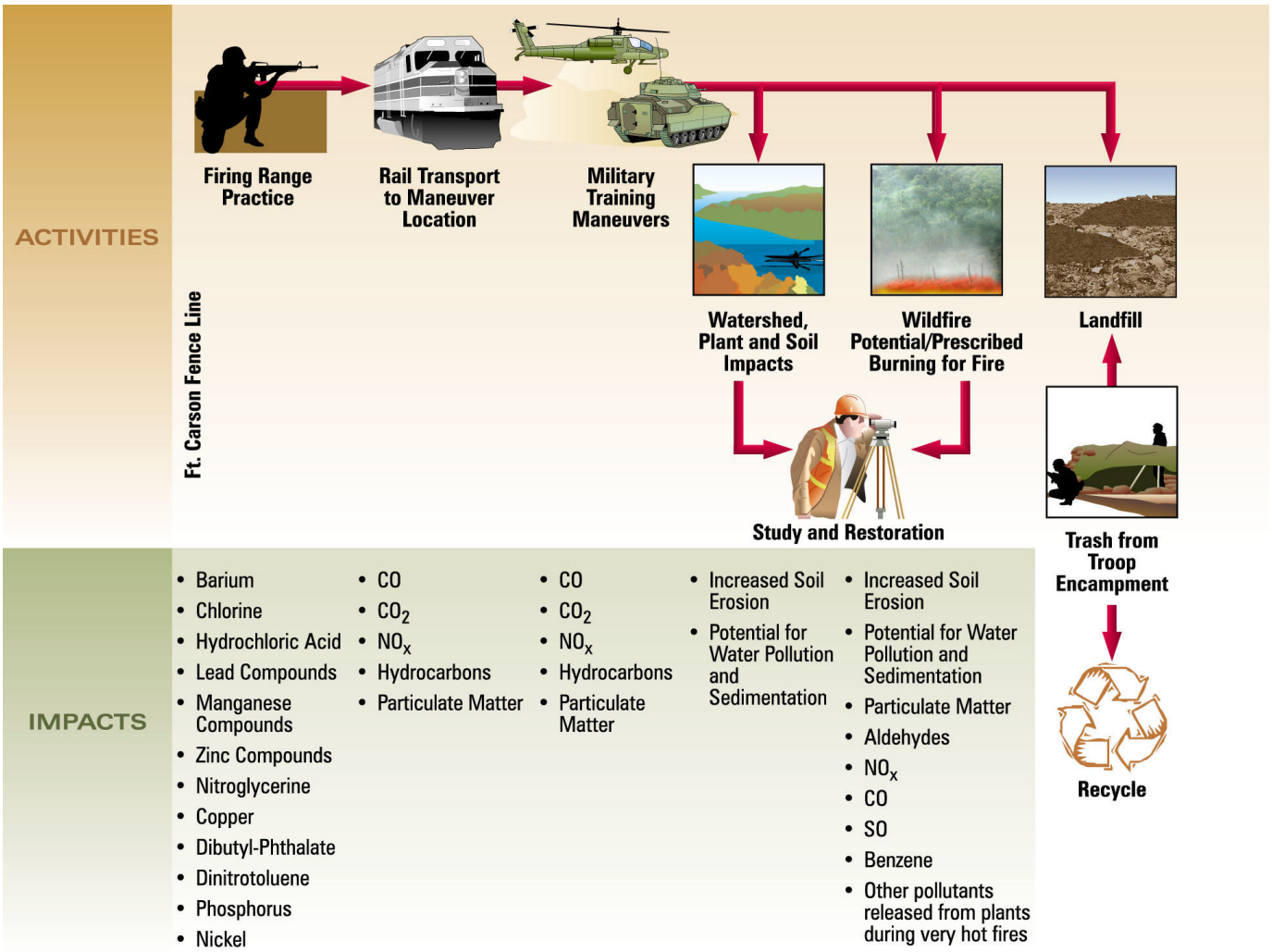


Figure 5.2 does not include details on solid or hazardous waste disposal and recycling. For more information on these activities, see the Materials section in this Baseline Document. For more information on open burning, open detonation, and smoke and obscurant training, see the Air Quality section.

The following sections provide more information on four major areas of land management: soil conservation, plant materials, wildfire management, and watersheds/wetlands. The DECAM and the G3, DPTM administer many of the land management activities in partnership because the programs are related and overlap in many respects. For both directorates, the mission is to conserve the land for future military training. Methods may vary and activity levels can be dissimilar, but the two groups must work together to maintain soil, water, and vegetation. The DECAM works with the Installation Fire Department to reduce and control wildfires.

Soil Conservation

Soil is the foundation upon which all training is performed and all activities take place. Soil origin, the semiarid climate, and intense, localized rainstorms shape the character of southern Colorado's high prairie soils. Parameters for training based on soil moisture exist and are heeded by training personnel. However, data on soil moisture is sparse, and often based on widely spaced weather stations. Fort Carson does take measures to prevent erosion and repair areas that have been damaged due to military maneuvers and previous poor land practices. Bank sloping, erosion-control dams, administrative controls (Limited Use Areas, for example), land rotation, seeding, hardened crossings, and incorporation of geotextiles are a few ways in which Fort Carson prevents or repairs erosion. Figure 5.3 is a list of the primary activities for erosion control practiced downrange at Fort Carson and the Piñon Canyon Maneuver Site.

Figure 5.3 – Primary Erosion-Control Activities

Soil Conservation Activity	Description	Fort Carson's Efforts
Map Overlays	Delineate Limited Use and Off Limits areas.	Provided to troops prior to submission of training plans.
Bank Sloping	Contour steep banks of erosion courses to an angle where vegetation can be established.	Ongoing. Evaluation continues to plan the best way to bank slopes while protecting species that use steep slopes for habitat and permit military training in an area.
Seeding	Perennial native grasses seeded to stabilize soil (prevent erosion).	Approximately 6,000 acres annually.
Erosion-Control Dams	Slow down runoff waters and cause sediment to drop out of runoff.	800 erosion-control dams completed.
Geotextiles	Placed under roads to maintain road integrity to support maneuvers and to absorb and slow the velocity of water down a slope.	Approximately 1,000 square yards.
Hardened Crossings	Help vehicles get across drainages with minimal damage to ecosystems.	3 to 25 per year are built.
Controlled Burning	Intentional lighting of fires to prevent out-of-control wildfires and give soil nutrients.	See Fire Section in this chapter.

Soil moisture is one of the most important factors related to erosion and military training. Training in extremely wet conditions can cause excessive impacts to the land—impacts that may take years to correct. Commanders are given "red," "green," and "amber" designations for training, based on field conditions. Soil moisture is difficult to measure over large areas. More instruments with better accuracy tied to a central database would improve communication and avoidance of training-related damage in extremely wet conditions. A weather station system with 12 soil moisture probes at the Piñon Canyon Maneuver Site and 5 probes at Fort Carson is nearly complete. This system will support the Maneuver Damage Control Program. However, due to the occurrence of localized rainstorms, the system will not provide full coverage of soil moisture conditions at the Installation.

On much of the high prairie in southern Colorado, erosion causes naturally occurring selenium to become available. Selenium attaches to eroding soil particles, which can be deposited in a single area, concentrating the selenium. Taken up by plants, selenium is toxic to wildlife in high concentrations. Even though no government standard for selenium in soil exists, Fort Carson recognized the potential hazard and proactively remediated 136,000 cubic yards of selenium-concentrated soil at a test site in a major training area during fiscal year 2001.

Range conservationists at Fort Carson have been creative in working with other agencies to carry out needed studies and monitoring with limited funding. Agreements have been made with the U.S. Geological Survey, the Natural Resources Conservation Service, and the Agricultural Research Service to study and assess erosion and sediment transport on the rangelands of Fort Carson and the Piñon Canyon Maneuver Site. The Massachusetts Institute of Technology and Oxford University are studying gullying processes at both sites. The University of Alaska and Shriever Air Force Base have used remote sensing imagery to study soil moisture at PCMS. This is only a partial list of studies and cooperative ventures accomplished between agencies and universities to enhance ecosystem sustainability.

Plant Materials

Semiarid plant communities such as those at PCMS and Fort Carson take many years to establish and grow. The Piñon pine produces seeds only once every two to five years. Juniper and prairie grasses cover large areas and stabilize soils, but with limited rainfall in intense bursts during the growing season, growth requires a delicate balance of soil nutrients, moisture, and minimal disturbance. Another issue is native plant species composition. Invasive plant species can degrade an ecosystem because they prevent native plants from growing, but lack the strong root system needed to stabilize soils. Invasive plants can also adversely affect wildlife health. Maintenance of native plant communities is critical to sustaining the military mission and the environment.

Trees and shrubs help reduce noise and improve air quality and military training. These forest resources help stabilize soils, provide concealment for tactical vehicles and personnel, and allow for realistic training by using the resources present in a given landscape. Trees damaged by maneuvers are inventoried and replaced where necessary to support both the ecosystem and accomplishment of the military mission. Forest inventory data taken in 2001 will be compared with earlier studies to determine to what extent the forest is changing as a result of military training and wildfires. Figure 5.4 details the costs for trees planted and maintained in 2001.

Figure 5.4 – Tree Expenses for 2001

Activity	Cost
Labor (watering, planting, pruning, and transplanting)	$71,260
Equipment and Maintenance (trucks, chippers, chainsaws)	$38,601
New Trees (tree, topsoil, mulch, etc.)	$22,080
Earth Day (42 new trees, topsoil, equipment, etc.)	$6,897
Total	$138,838

Trees can be damaged by the improper design of landscaping. In the Fort Carson cantonment area, some of the landscaping materials and methods used include rocks, xeriscape plant materials, and previously planted Kentucky bluegrass. Kentucky bluegrass must be watered one inch per week from May to September (about 22 inches is needed). The Pikes Peak region receives an average annual rainfall of approximately 12 inches (http://lwf.ncdc.noaa.gov/oa/ncdc.html); thus, the water needed to maintain Kentucky bluegrass is much greater than that which naturally falls. This is too much water for many native trees, and their roots will rot, so native trees should not be planted near areas with Kentucky bluegrass. Initial purchase and planting for xeriscaping is typically more expensive than for Kentucky bluegrass. However, life-cycle cost analysis of water requirements during the growth years indicates that bluegrass is much more expensive than xeriscaping or using native grasses.

A native grass and forbs mixture is used for reseeding training areas at both Fort Carson and PCMS. Areas requiring reseeding are prioritized based on percent disturbance, plant cover, native plant composition, and wildlife habitat conservation requirements.

Invasive plants have been referred to as a form of biological pollution. International travel for pleasure, work, and military activities has brought many species into the United States accidentally. However, many species that were imported for decorative and agricultural purposes have subsequently gotten out of control. Invasive plant species are a major ecological problem in the western United States. Plant species that are not native to the area can harm wildlife, cause soil erosion, compete with native species, consume wetlands, and affect the Army's ability to train. Five different invasive plants have caused the most problems, but ten others exist in the area and have the potential to spread. Invasive species are a larger problem at Fort Carson than at PCMS, due in part to prior management histories and to intensive native plant reseeding efforts during the 1980s and early 1990s at PCMS, which is more arid.

Fort Carson is using a variety of methods to control invasive species in accordance with its Integrated Pest Management Plan and INRMP. Education and biological, physical, chemical, and cultural controls are used where appropriate to prevent invasive plant species from spreading and to lessen their effects. Weed control costs average approximately $80,000 per year.

Wildfire Management

According to Todd Wilson, in an article titled "Prometheus Unbound" in the May/June 2001 issue of Nature Conservancy,

- approximately $1.6 billion was spent in 2000 to put out 90,000 wildfires in the United States; and
- for every dollar spent on prescribed burning, forest thinning, and fire personnel training, $7 are saved in wildfire fighting costs.

Preventing wildfires is important in the semiarid west. Wildfires burn off extensive areas of plant material, allowing excessive erosion of soils and damage to aquatic systems. Prior to the 1980s, wildfire management focused on preventing all fires at all costs. Subsequently, resource managers realized that preventing all fires allowed the accumulation of dead, dry fuel materials on the ground. In these circumstances, once a fire started, it raged out of control over large areas for days, aggravating existing air pollution conditions and putting firefighters in high-risk situations.

Controlled or prescribed burns are a preferred method for controlling wildfires; reducing soil damage and air and water pollution; and reducing the risk to firefighters. Prescribed fires are more than a way to prevent wildfires from raging out of control; small fires release important nutrients back into the soil, and reduce undergrowth and deadfall, which allows the remaining trees to grow and remain healthy for a greater number of years. Prescribed fires save hundreds of thousands of dollars in training time lost and in money required to fight wildfires. From a community perspective, prescribed fires reduce the impacts of smoke from wildfires and minimize the risk of wildfire damage to residential areas. For military training purposes, prescribed fires allow for increased training by creating buffer zones at live-fire ranges. In addition, prescribed fires control the growth of invasive plant species (removal of vegetation makes plant-specific herbicides more effective). Thus, prescribed burning is an environmentally sound way of clearing areas for training purposes and preventing training land losses due to wildfire degradation.

Prior to this year, El Paso County restricted prescribed burning from November through March due to air quality issues. Burning is not allowed on days when there are atmospheric inversions. These winter months are the best time to burn due to the fact most of the native grasses are dormant and will not be harmed by the fire, and the cold and dampness allow better fire control. Before control burn permits can be issued, very strict guidelines must be met. Fort Carson must coordinate all burns through both the affected County Health Department and the Colorado Department of Public Health and Environment (CDPHE) in order to abide by existing air quality regulations.

Approximately 26,000 acres are scheduled for prescribed burning annually. However, only 3,000 to 10,000 acres are actually burned due to weather conditions, training activities, and other factors. In compliance with legal requirements and sound management, Fort Carson does not perform prescribed burning unless all appropriate notifications have been made, fuel conditions and moisture are adequate, and weather conditions for proper smoke dispersal without high winds exist. Boundaries such as roadways, natural rock outcrops, and high expansion foam are used to contain prescribed fires. Studies are being coordinated with Utah State University to determine the feasibility and cost effectiveness of vegetative firebreaks, which are one of the tools being considered in Fort Carson's environmentally sound approach to ecosystem management.

New changes in the law for prescribed burning have just taken effect. Beginning in 2003, a fee must be paid to CDPHE for a prescribed burning permit. Additionally, a public comment period for each burn permit and a post burn report must be submitted. Fort Carson's Prescribed Fire Program has operated successfully without incident since 1989. It is unclear whether new regulations will aid or hamper burning activities at Fort Carson and the Piñon Canyon Maneuver Site, but it is certain that the additional coordination and fees will cause prescribed burning to cost quite a bit more.

Watersheds and Wetlands

A watershed is a drainage basin that divides the land into hydrologically defined areas. A wetland is an area that is inundated by enough water for a long enough period to support plants that require saturated soil conditions. Wetlands have been called "the kidneys of a watershed" because they filter and clean the water. Wetlands sustain plant and animal diversity; protect against flood and storm damage by absorbing large amounts of water; and increase groundwater availability through capture and filtration of

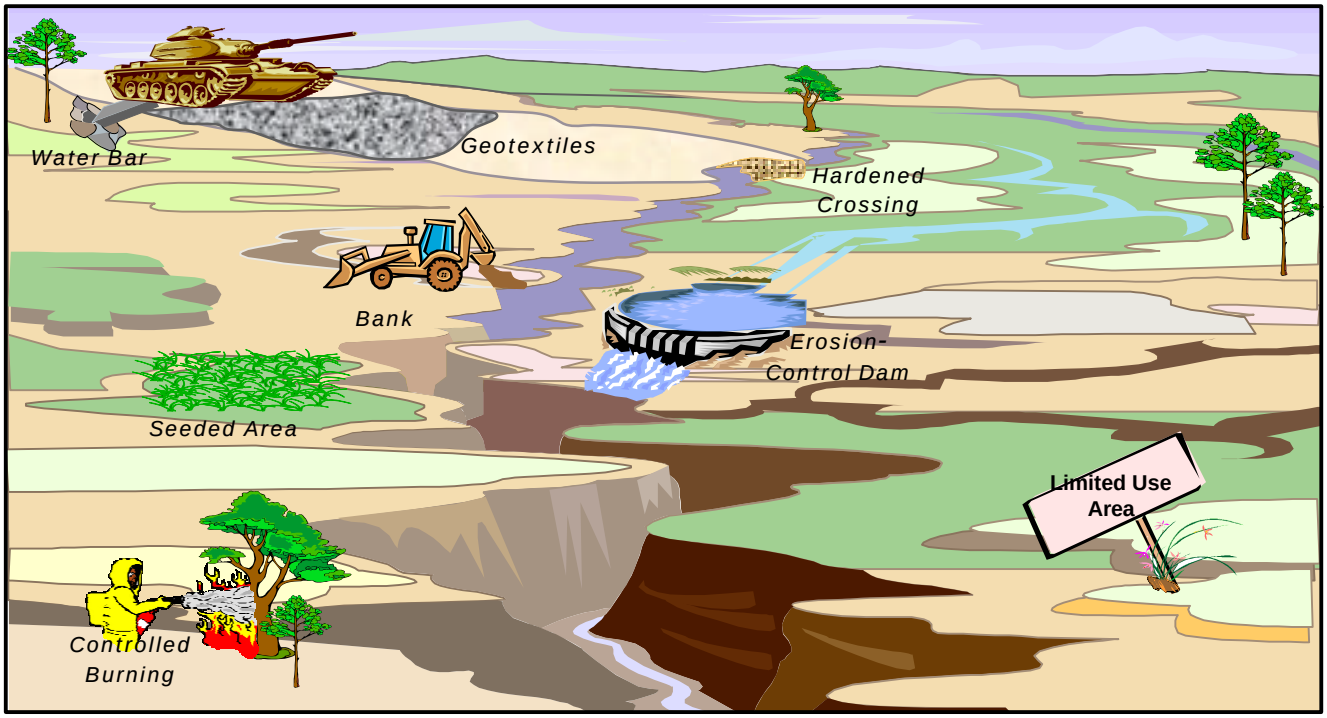
precipitation. Wetlands at PCMS include arroyo pools, ephemeral streams, and those created by erosion-control dams. Wetlands at Fort Carson include manmade areas, wetlands created by erosion-control dams, ditches, and areas associated with natural drainages.

Since the arrival of European settlers on the land that is now the United States, approximately 100 million acres of wetlands have disappeared due to draining and filling, primarily for agriculture purposes. Replacing wetlands is difficult and not always successful; thus, it is best to preserve natural wetlands and plan activities and structures around them.

The National Wetlands Inventory recognizes 40 categories and 1,076 acres of wetlands at Fort Carson and 31 categories and 4,776 acres of wetlands at the Piñon Canyon Maneuver Site. This data was gathered in 1993, and the survey will be repeated in order to determine if wetland areas are decreasing or increasing.

The Watershed Management Plan is implemented in part with soil conservation projects to conserve training lands. If soils are not protected, water will accelerate the natural erosion process. Some of the most important methods for conserving watersheds are listed in Figure 5.3 and shown graphically in Figure 5.5.

Figure 5.5 – Activities and Practices that Preserve Military Training Lands



Erosion-Control Dams – These and smaller "check dams" collect sediment and decrease water velocity, thus reducing water-generated erosion.

Water Bars – Water bars divert water from tank trails that have high erosion rates, thereby preventing excessive erosion and stabilizing the road.

Geotextiles – Geotextiles protect roads by allowing water movement while preventing movement of soils.

Hardened Crossings – When vehicles must pass through wet or muddy areas, damage is done in that area and beyond. Hardened, rock-lined crossings are passages through wet or muddy areas that reduce damage and confine traffic to a single area for crossing.

Bank Sloping – Contouring steep banks changes the slope of gully walls from near vertical to a much gentler slope, allowing passage of vehicular traffic and establishment of vegetation to stabilize gully walls.

Limited Use Areas – By limiting training in an area, lands are allowed to recover. During training, troops designate these areas as chemically contaminated or mined (that is, areas that would be avoided on a battlefield) to simulate conditions in real war and enhance training. Limited use areas are marked on maps and overlays and identified on site with signs and flagging.

Vegetation Establishment – Bare or inadequately protected soils are reseeded to prevent erosion. If the germinated seedlings survive for more than six months, they are considered established.

Most of the watershed protection projects are primarily reactive measures to control erosion. The production and use of real-time soil data could prevent some erosion from happening in the first place. If connected to a central information system that range managers and commanders accessed directly, the risk of training to a particular area could be determined immediately. Yearly aerial photographs would show where tree or vegetation lines are moving and if excessive losses are occurring in a particular area. Proactive conservation of available training lands will remain important in the coming years to sustain Fort Carson's limited resources.

The Human Perspective

As long as threats against the United States exist, soldiers will need places to train realistically and effectively. Simulations do not necessarily put the soldier in realistic war fighting situations with unpredictable conditions. The soldiers know they can always survive a simulation, and experience in coping with variability is key to building confidence in unknown situations. While learning to protect our country from external threats, soldiers must also learn how to prevent excess environmental damage to support the training mission in perpetuity. Soldiers care as much about the environment as any other citizen of this country. When provided with the proper education and tools, U.S. Army personnel have proven to be excellent stewards of the land.

Beyond the Pikes Peak Region

Respect for land at home will carry over to maneuvers at other installations and deployments to other countries. Good practices at both Fort Carson and the Piñon Canyon Maneuver Site create more environmental leadership within the Armed Forces. Foreign relations can only be improved by demonstrating care for other lands while fighting a war or performing peacekeeping missions.

Forecast

The Army has an ever-increasing need for versatile training that teaches soldiers how to respond to a variety of situations. Particularly important in coming years may be the ability to train in urban environments. This requirement may mean that troops will train less in open settings and more at a centralized camp converted to an urban warfare center. Alternatively, it may mean the conversion of some existing land at Fort Carson and Piñon Canyon Maneuver Site to urban warfare sites.

As the use of computer simulators increases, it would seem that the need for training lands would decrease. However, realistic outdoor training situations will always be necessary to prepare soldiers for war. Computer simulators are widely viewed as a supplemental training tool, not as a substitute training method.

Fort Carson billeting does not have the capacity for a large mobilization-training situation. This could mean the use of temporary tent quarters, which will require more intense study and care of the lands used for this purpose. Further, a large mobilization will require a more thorough and extensive use of training lands.

As weapons' maximum effective range increases, safety zones or "fans" will need to increase, requiring more land use. This development may be an asset to the land and its inhabitants, as more land is set aside for safety purposes, and used less for intense training, development, or other agricultural purposes.

Finally, the trend is for increasing environmental requirements, which will necessitate additional coordination among various agencies managing the Installation's natural resources and more environmental training for soldiers, civilian employees, and members of the public.

Current Sustainability Activities

Integrated Training Area Management (ITAM) – Aspects of this program include monitoring and inventory of training land conditions, an environmental awareness program, the Maneuver Damage Control Program, rehabilitation and revegetation programs, a computerized system for scheduling military and rehabilitation programs, a geographic information system, and integration of the mission and natural resources programs.

Land Condition Trend Analysis Program (LCTA) – Part of the Integrated Training Area Management Program, the Land Condition Trend Analysis Program provides information to assess the land's ability to support training. In accordance with this program, Fort Carson monitors the percent change in vegetative cover at the Piñon Canyon Maneuver Site and Fort Carson.

Land Rehabilitation and Maintenance Program (LRAM) – This program reduces the long-term impacts of training and testing on an installation by combining preventive and corrective land rehabilitation, repair, and/or maintenance practices. It includes training area redesign and/or reconfiguration to meet training requirements.

Watershed Management Program – The Watershed Management Program divides the Installation into its watersheds and manages them based on hydrology, soils, erosion status, wildlife, military training, and maneuver damage. In conjunction with the Wetland Monitoring Program, this program is used to define change on maneuver lands to the extent possible and to develop techniques for mitigating training impacts.

Awareness and Education Programs – Fort Carson personnel give tours, presentations at area community colleges, and instruct soldiers on the proper care and management of the land. They have created and distributed several educational videotapes.

Meteorological Monitoring Network – A network of 17 meteorological monitoring stations was established to monitor weather conditions and soil moisture. The stations provide continuous data on precipitation, temperature, wind, air pressure, solar radiation, and soil moisture.

Plant Materials Program – Cross breeding and selecting better plant varieties are methods used to produce plant materials that resist damage from military use.

Cooperation with Military Units – Fort Carson's land managers cooperate with military troop units, such as the 52nd Combat Engineer Battalion (Heavy), to perform work that supports the land and the military mission. The 52nd Engineers recently excavated sediment from the impaired areas of several erosion-control dams to learn how to perform similar operations as part of their tactical mission.

Computerized Water Monitoring System – The U.S. Geological Survey considers Fort Carson's water monitoring system as one of the best in the state of Colorado. This system was made even better by installing a computerized water monitoring system that provides extensive water flow data at Fort Carson.

Agreements with Other Agencies – Fort Carson makes every attempt to partner with other scientific and conservation agencies. A partial list of partners follows.

- Colorado College
- Colorado Division of Wildlife
- Colorado Division of Parks and Recreation
- Colorado State University
- El Paso County Parks
- El Paso County Soil Conservation District
- Fountain Creek Watershed Task Force
- Peterson Air Base
- Purgatoire River Soil Conservation District
- Schriever Air Force Base
- Texas A&M University
- Texas Regional Institute for Environmental Studies
- U.S. Agriculture Research Service
- U.S. Air Force Academy
- U.S. Army Corps of Engineers, Construction Engineering Research Laboratory and Waterways Experimental Station
- U.S. Bureau of Land Management
- U.S. Department of Agriculture
- U.S. Fish and Wildlife Service
- U.S. Geological Survey
- U.S. Natural Resource Conservation Service
- University of Wyoming

The Realm of Possibility

To become sustainable, Fort Carson is encouraged to identify and plan for innovations that will support the goals established during the Installation Sustainability Workshop. To do this, participants should review the concepts and technologies that are within the realm of possibility now and in the future. This section provides a glimpse of what can be accomplished with existing technology and what can be expected from developing sustainability approaches.

Training Land Conditions

- **Green Bullet** – The "Green Bullet" program is a Department of Defense (DOD) initiative to eliminate the use of hazardous materials in small caliber ammunition and during its manufacture. This fully integrated program, which is spearheaded by the Small Caliber Ammunition Group at the U.S. Army's Armament Research, Development, and Engineering Center (ARDEC), encompasses all environmental aspects of the small caliber ammunition from 5.56 mm through 0.50 caliber. Specific thrusts include the elimination of ozone-depleting chemicals (ODCs), volatile organic compounds (VOCs), and heavy metals in the manufacture of primers and projectiles in the entire family of small caliber ammunition. For more information, see the Green Ammo web site (https://www.pica.army.mil/greenammo/), which requires a secure channel.

- **Green Missile** – The Green Missile Program, an integrated pollution prevention research effort funded by the Strategic Environmental Research and Development Program (SERDP), is designed to develop alternative materials and technologies for solid rocket motor propulsion systems. The program has team members representing the Army, Navy, Air Force, National Aeronautics and Space Administration (NASA), Department of Energy (DOE), and Environmental Protection Agency (EPA). The specific objectives of the program are to (1) develop propellants for both extrudable and castable propellant processes that do not contain lead catalysts; (2) develop and demonstrate complete and clean hydrochloric acid-free combustion; and (3) develop and demonstrate the use of liquefied gases and supercritical fluids for environmentally friendly processing of energetic oxidizers and components, resulting in elimination of solvents and reduction of VOCs in the waste stream.

- **Virtual Training –** "Virtual training" is the next step in readiness training for the U.S. Army. While flight simulators and interactive shooting ranges have been in use for years, the next generation of virtual training systems will incorporate unprecedented realism and give soldiers the ability to experience complex and dangerous combat scenarios in a 100 percent controlled environment.

- **Decision Support Software –** Geographic Information System (GIS) decision support software, specifically designed to address military maneuvers with environmental conditions, is available.

Management tool software packages include maps, impact analysis, and a training area/range facility management support and scheduling system. Examples of available maps may be found at http://www.nobility.com/.

- **Range Facility Management Support System –** The Range Facility Management Support System (RFMSS) is an automated range and training area scheduling system currently used by the Army. This system provides centralized scheduling of range assets and detailed reporting capability. The system increases overall safety for the training soldier. This automated range scheduling capability increases range operation efficiency by replacing the previous paper-based system with a software package that incorporates current GIS software into a graphic user interface. RFMSS allows Range Control to coordinate all scheduling functions, including approval/disapproval of requests. The current-day approved requests are handled at the Firing Desk in a crucial, real-time module of RFMSS. All data is archived for future range utilization reporting. An online example of this software package may be found at http://rfmss.lmfs.belvoir.army.mil/.

- **Sustainable Range Design –** The U.S. Army Corps of Engineers is currently exploring the connection between green building design concepts and sustainable range design.

- **Tactical Concealment Area Planning –** The Tactical Concealment Area Planning and Design Guidance Document, developed by the Army Environmental Center and the Army Engineer Research and Development Center, is an approach to designing training land that integrates training and environmental requirements to expand and improve training resources. Go to the following U.S. Army Environmental Center web site technology section for more information: http://aec.army.mil/usaec/technology/conservation06.html.

- **Camp Ripley Study –** A two-year study was conducted at Camp Ripley, Minnesota to determine the effects of tracked and wheeled tactical vehicles on soils and vegetation. The study provided scientific information concerning soil compaction and sensitivity of trees to intense military use (http://www.dma.state.mn.us/cpripley/envir/land_use_management.htm). While the environment in Minnesota is quite different from that of Colorado, the application and theory of the system is worthy of consideration.

- **Zero Footprint Camp –** The Zero Footprint Camp was developed as a way to alleviate the logistics and tactical burden of deployment. Zero Footprint Camp is a method of identifying wastes as products to be used in other processes. For example, wastewater should be viewed as untreated, impure water that simply needs cleaning and disinfection for use. More information may be found at http://www.haifire.com/download/zfc.pdf.

Endangered Species

- **Greenbelts –** Fort Bragg has established a 5,538-acre "Greenbelt" on the southern border of the installation. Military training continues on this land but it is otherwise left undisturbed as habitat for the endangered red cockaded woodpecker. Similar greenbelts could be established at other installations to protect local endangered species.

Noise

- **Weather and Training –** The rate at which wind speed and temperature change as a function of altitude can have profound effects on the behavior of high-energy sound waves as they propagate off-range and many miles into the surrounding area. As weather conditions change, noise monitoring many miles from the firing point and impact area has shown 30-decibel variations within just a few hours for a single weapon and firing point. For a local resident, this amounts to an eight-fold increase in loudness over a very short time period. Regular sampling of meteorological conditions and good record keeping can help identify adverse conditions and lead to strategies to avoid them. Disclosure of this information and the role that weather can play in noise levels at the point of reception can do a great deal to improve the trust and credibility accorded the leadership at the range.

- **Night Training –** Training between 2200 and 0700 hours has noise impacts that are especially difficult for local residents to cope with because of the lower background noise at night and the probability of being awakened. Much of the night training serves to teach proficiency in the dark, which is not necessarily associated with the sensitive 2200 to 0700 period. Spring, fall, and winter months have many hours of darkness before 2200, and in many cases, it is possible to keep the large weapon component of the training in the period between sunset and 2200 hours.

Encroachment

- **Private Lands Initiative –** The Private Lands Initiative (PLI) is a cooperative effort between the U.S. Army Forces Command (FORSCOM), The Nature Conservancy, the U.S. Fish and Wildlife Service, and private landowners around the borders of an installation. By annexing land around the fence line and preventing that land from being developed, the PLI creates a "buffer zone" of sorts, which improves wildlife habitat around the edge of an installation. Increased habitat for endangered species outside the fence line decreases training constraints inside the fence line. The PLI, which has been active at Fort Bragg since 1995, is currently reviewing 10,000 to 20,000 acres of prime habitat of the red-cockaded woodpecker.

Water Quality

- **Living Machines –** Living Machines® use bacteria, plants, snails, and fish to treat sewage and other wastewater (http://www.livingmachines.com). The machines look like greenhouses and work by using plants and animals to break down wastes and digest organic pollutants. They are made by Living Technologies, Inc., and have been permitted at 23 locations in 7 different countries, including the United States. They offer better, more stable treatment at the same cost as traditional sewage treatment. It is possible that a similar technology could be developed to control the potential release of pollutants from ranges into groundwater and surface waters. The Army's Sustainable Range working group is charged to develop new ways to design the ranges of the future to reduce contamination by pollutants.

- **Low-Impact Development –** Low-impact development techniques can minimize impervious areas, thereby maximizing groundwater recharge (http://www.stormwater.net). Proper management of storm water protects surface water and groundwater from contamination, which is critical to Fort Carson and the surrounding region.

- **Porous Pavement –** Contaminants (oil, fuel, and sediments) that cause problems with storm water are eliminated if the storm water is retained on site and allowed to seep into the soil, rather than running off into streams. Many new building techniques and materials, such as porous pavement, allow for such natural drainage and on site water storage (http://www.stormwater.net).

- **Xeriscaping –** The Colorado Springs Water Resources Department has a Xeriscape Demonstration Garden at 2855 Mesa Road. The garden demonstrates how to plan the landscape, improve soil, select low water use plants, irrigate effectively, use mulches, and maintain the garden, all with low water consumption in mind.

- **Doppler and GIS –** The Doppler weather radar system can give full coverage of the weather in an area. Even small areas can be plotted on a GIS map to aid in predicting soil moisture, thereby determining the level of training the land will tolerate without significant damage.

Fort Carson 25-Year Goals for Lands

To be determined by Fort Carson Command and staff, as advised by members of the local and regulatory communities, at the Installation Sustainability Workshop on 4-6 September 2002.

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