Challenge

The State of Colorado is concerned about air quality along the Front Range because it is one of the fastest growing regions in the United States. Decreases in carbon monoxide and particulate matter that have occurred over the past 15 to 20 years will be offset in the future by the increased automobile use, industrial activities, and fuel burning for heat and electricity that will accompany the increasing number of people moving into the area. As regional air quality deteriorates, Fort Carson's allowable emission limits on air permits will be tightened. How can Fort Carson sustain the military mission, minimize administrative and operational costs due to air permitting, and help protect regional air quality?

Key Considerations

- **Training** – Regional air quality issues can influence training activities such as those requiring use of smokes and obscurants. Modifications in specific activities can reduce the likelihood of specific restrictions in the future.
- **Energy Use** – Generation and use of energy affect regional air sheds. Efficient buildings and renewable energy sources reduce impacts to the air and can reduce long-term costs.
- **Transportation** – Continuing to participate in the development and implementation of a regional mass transit plan with the Pikes Peak Council of Governments will support regional air quality objectives. The Destination 2025 Plan will improve regional air quality, reduce traffic congestion, and contribute to a better community-installation partnership.
- **Product Selection and Use** – Identification and use of environmentally benign chemicals for operations and maintenance (O&M) functions and mission activities can reduce impacts and costs while improving mission readiness and worker safety and health.

Importance to Fort Carson

Mission – Training-related smoke activities are limited by Fort Carson's air permit. Reporting and approval paperwork for use of grenades, fog oil, and smoke pots in training activities can be cumbersome. A three-kilometer buffer zone, in which no smoke-related training activities may take place, has been

established around the entire perimeter of the Installation.

Quality of Life – Clean air is critical to good quality of life for soldiers and their families. Asthma rates in cities continue to rise, and air pollution can cause many other health problems, such as reduced lung function, susceptibility to respiratory infections, increased risk associated with existing heart conditions, and respiratory system irritation.

Costs

- The estimated costs to run Fort Carson's air program in 2002:
  - Sampling and Monitoring: $5,000
  - Title V Operating Permit: $68,800
  - Emissions Inventory: $34,000
  - Emission Impact Reviews: $20,000
  - Personal Vehicle Emission Surveys: $8,000
  - Ozone-Depleting Chemical Phase Out: $26,000
  - Fees and Permits: $30,000
  - Dust Mitigation: $300,000
  - Total: $498,800
- Total cost to eliminate and replace ozone-depleting chemicals at Fort Carson: $164,919.
- Cost to provide a new paint booth at Building 8000: $500,000.
- Cost to replace the two Building 1860 boilers: $200,000.
- Fort Carson is currently involved in negotiations with the Colorado Department of Public Health and the Environment concerning permit violations noted during an inspection in 2000. All violations have since been corrected.

Environment and the Community – According to Val Viers, a professor in Physics and Environmental Science at Colorado College, Colorado Springs is likely to violate National Ambient Air Quality Standards (NAAQS) for carbon monoxide on a regular basis by 2030 (http://www.coloradocollege.edu/Publications/access/february1997/4EnvironmentalScienceAquires.html). As a member of the regional community, Fort Carson must continue proactive environmental stewardship activities and limit its contribution to ambient air pollutants.

Introduction

The scenic mountains to the west of Fort Carson pose a special challenge to air quality; they serve as a wall preventing dispersion of pollutants. The mountains and high altitude of the region also cause a winter

phenomenon known as atmospheric inversion, the trapping of cold air beneath warm air, which concentrates
pollutants at lower levels. If population growth and automobile use continue to expand at the current rate, air
quality problems will be exacerbated. As air quality diminishes, quality of life decreases and respiratory
illnesses increase. As an inevitable consequence of deteriorating air quality, permit restrictions and
regulatory requirements increase and become more stringent, affecting the Army's ability to train effectively
for its mission.

Background

As with any installation or industrial activity, Fort Carson has emissions specific to its mission and not
related to building or vehicle emissions (detailed in the Energy and Transportation sections of this
document). The largest emissions (Figure 2.1) occur in four areas: Training Activities, Vehicle Maintenance
Activities, On-Site Utilities Equipment, and Cantonment Activities.

Figure 2.1 – Sources of Air Pollutants at Fort Carson

Training Activities
Smoke and Obscurants
Vehicle Maintenance Dynamometers Dynamometers Dynamometers
Bldg 8000 Paint Booths
On-Site Utilities Equipment
Bldg 1860 Boilers
Bldg 1860 Boilers
Bldg 6290 Generators
Bldg 1860 Boilers

Bldg 6290
Generators
Bldg 1860
Boilers
Hospital
Generators
Cantonment
Activities
Unpaved
Haul
Roads
Bldg 900 Svc
Station
Bldg 1515 Svc
Station
Base wide
Chemical Use
Basewide
Chemical
Use
Bldg 900
Svc Station
Red = Largest Source on Fort Carson
Blue = Second Largest Source on Fort Carson
Green = Third Largest Source on Fort Carson

Many activities are included under each of the four major categories (Figure 2.1). Training activities refer to those activities performed in the field, such as smoke and obscurant use and weapons firing. Tactical vehicle movement on unpaved tank trails creates fugitive dust. Open burning and open detonation are performed in the field to eliminate unused ordnance. Vehicle maintenance activities are required to keep troops moving and practicing for war. On-site utility equipment, such as boilers and emergency generators, keep buildings that are not connected to the power grid comfortable and ensure uninterrupted systems operations during

power outages. Cantonment activities include miscellaneous emission sources such as gas stations, storage tanks, and landfills.

A Word about Ozone-Depleting Chemicals

Fort Carson maintains an active plan to eliminate the use of Class I ozone-depleting chemicals (those with the greatest potential to destroy the ozone layer) in accordance with all Federal, State, and Department of Defense guidelines. These ozonedepleting chemicals are commonly used as refrigerants in refrigeration and air conditioning

units, solvents for cleaning and degreasing operations, fire extinguishing agents, and fumigants for killing pests and weeds. Retrofits with nonozone-depleting chemicals replaced all fire suppression systems with halon. Three ozonedepleting solvents used on the Installation are being reformulated. However, tactical equipment continues to have fire suppression systems that contain ozone-depleting chemicals; no substitutes have been developed that are as effective in suppressing a fire in an enclosed vehicle and thereby saving soldiers' lives. In an effort to assist with the regulatory compliance recordkeeping and reporting requirements associated with the use of refrigerants, the DECAM purchased a Refrigerant Compliance Manager software program.

Emission Summaries

Fort Carson monitors and controls annual emissions of the Clean Air Act's six defined criteria pollutants as well as Hazardous Air Pollutants. Figure 2.2 provides a summary of both criteria and hazardous and toxic air emissions from Fort Carson. These data do not include mobile emissions (e.g., vehicles) or emissions generated by Colorado Springs Utilities to supply power for Fort Carson. Figure 2.3 details specific emission source categories, including those that emit volatile organic compounds (VOCs) and nitrogen oxides. Nitrogen oxides and VOCs react together with sunlight to form harmful ground-level ozone.

Regulations At A Glance

Clean Air Act (CAA) – This federal legislation establishes permitting requirements and limits for activities that release air pollutants. Three major kinds of requirements apply:

1. **National Ambient Air Quality Standards (NAAQS)** – These standards regulate the amount of six criteria pollutants in ambient air. If regional concentrations of ozone, carbon monoxide, particulate matter (e.g. dust), sulfur dioxide, nitrogen oxides, or lead rise above certain standards, operational changes may be required at Fort Carson. The area is currently designated an Attainment/Maintenance area for carbon monoxide.
2. **New Source Performance Standards (NSPS)** – Construction or modification of facilities that may emit air pollutants requires a permit. The permitting process includes a health effects review and public comment opportunities.
3. **National Emissions Standards for Hazardous Air Pollutants (NESHAPs)** – The 1990 CAA

Amendments directed the U.S. Environmental Protection Agency (USEPA) to regulate emissions into the air of 189 toxic chemicals, called Hazardous Air Pollutants (HAPs), which are known or suspected carcinogens. Regulations specify emission limits according to industry categories. The Colorado Springs area currently is considered “in attainment” for the six criteria pollutants. However, population growth in the area will lead to increased vehicle-miles traveled, which may lead to nonattainment for ozone. In addition, the mountains limit air dispersion, diminishing air quality on a local or regional scale.

Figure 2.2 – Air Pollutant Emissions at Fort Carson

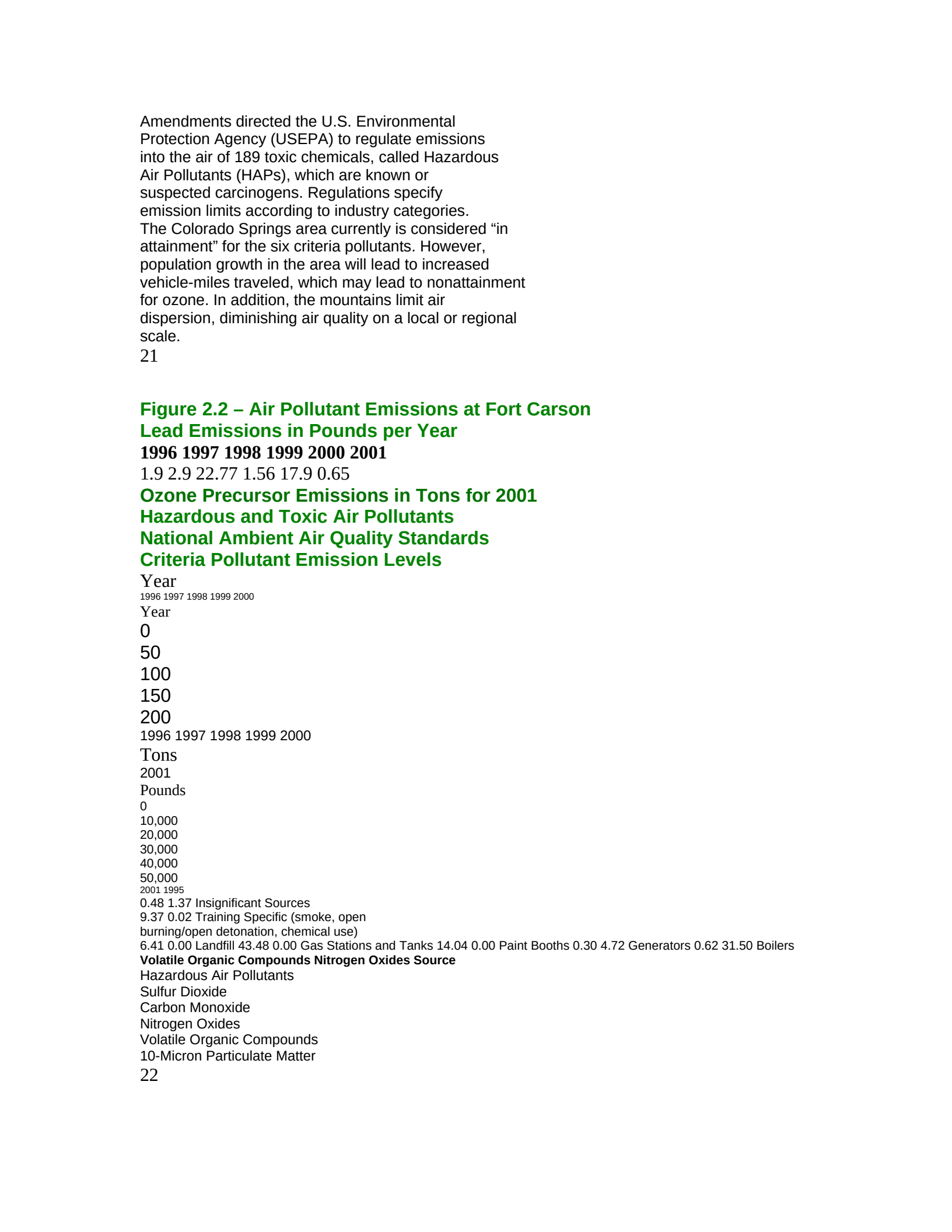

Figure 2.3 – Summary of Primary Air Pollutants at Fort Carson (tons per year)

Boilers 7.20 37.19 9.30 0.76 0.73 0.49 0.00
Engines/
Generators
0.34 3.45 0.76 0.39 0.20 0.00 0.00
Paint Booths 0.49 0.00 0.00 0.00 5.62 2.66 0.00
Gasoline Stations 0.00 0.00 0.00 0.00 33.17 2.44 0.00
Storage Tanks 0.00 0.00 0.00 0.00 0.57 0.71 0.00
Smoke and Open
Burning/Open
Detonation
11.66 5.83 0.02 0.01 3.23 0.02 0.00
Chemical Usage 0.00 0.00 0.00 0.00 15.77 2.29 0.01
Landfill-Related
Issues
0.00 0.00 0.00 0.00 12.40 0.64 0.01
Storage Piles and
Haul Roads
21.83 4.64 0.00 0.00 0.00 0.00 0.00
On-Site Utilities Equipment Vehicle Maintenance Activities
Cantonment Area Activities Training Activities

Activities and Impacts

The primary activities listed in the Installation's Title V Air Operating Permit are grouped into five major
emission source categories: painting, on-site heat and power generation, vehicle maintenance activities,
landfill emissions, and training activities. For this Baseline Document, the aggregate categories are On-Site
Utilities Equipment, Vehicle Maintenance Activities, Cantonment Activities, and Training Activities.

On-Site Utilities Equipment

Fort Carson does not obtain all of its power from Colorado Springs Utilities. Some areas are too remote or
not connected to the main grid, and some areas must have stand-by sources of power in

cases of power
outages. Because electricity from the power grid cannot heat all areas, Fort Carson uses boilers. Generators
are important to medical, food storage, and other facilities in case of power outages.
Fuel oil is transported to the Installation for use in fuel-oil boilers and generators (Figure 2.4). Pollutants
resulting from the combustion of fuel oil include carbon dioxide (a greenhouse gas), sulfur dioxide
(contributes to acid rain), and nitrogen oxides (ozone precursors and lung irritants). To reduce the levels of
sulfur dioxide resulting from the burning of fuel oil, Fort Carson purchases low-sulfur, distillate fuel oil.
Diesel is transported to the Installation for use in some small generators. Diesel fuel contributes the same
types of pollutants as fuel oil, but with the potential of increased sulfur dioxide emissions. Natural gas is
piped to the Installation for use in the majority of heating systems.

Figure 2.4 – Major Sources of Air Pollution from On-Site Utilities Equipment

Vehicle Maintenance Activities

Vehicles require regular repair, painting, and refueling to keep the Army moving. To support the
Installation's readiness mission and minimize air pollution, proper maintenance of all vehicles is extremely
important. Vehicles are often lifesavers in battle situations. Therefore, soldiers must know how to repair
them and must have the appropriate tools and materials to do so. Figure 2.5 illustrates the activities involved
in vehicle maintenance that cause air emissions; these are not necessarily in chronological order.
Fort Carson uses two types of parts cleaning solvents/systems. The traditional system uses a petroleum
naphtha-based solvent that is serviced by the vendor and recycled. Some motor pools use a new citrus-based
solvent and filter. The new system is environmentally superior because the filter allows longer solvent use
before its recycling.

Figure 2.5 – Major Sources of Air Pollution from Vehicle Maintenance

Touch-up painting is typically done with limited amounts of paint. Personal protective equipment is
required. After painting, solvents are used to clean the equipment. Welding occurs on an as-needed basis.

Miscellaneous activities that contribute minor amounts of emissions include battery charging (sulfuric acid)
and the use of adhesives for gluing in certain repairs.
For large paint jobs, vehicles are cleaned with soap, water, and solvent, and then taped for blasting. Blasting
removes paint, which combines with the blast material. At Fort Carson, blast materials are a combination of
plastic and garnet, which are returned to the vendor, recycled, and made into picnic tables, dog bowls,
planters, and other items. High volume, low-pressure paint guns are used to enhance application efficiency
by minimizing over-spray and conserving paint, thereby minimizing pollution. After vehicles are painted,
the tape is removed and the paint equipment must be cleaned with a solvent.
Paint used for tactical vehicles is a chemical agent resistant coating, also referred to as "CARC." The
chemical composition of CARC includes titanium dioxide, xylene, chromic oxide, butyl acetate,
hexamethylene diisocyanate monomer, ketone, and naphtha. As dangerous as these chemicals are, this type
of paint is critical in warfare for its resistance to chemical agents during chemical, biological, and
radiological warfare.

Additional sources of air emissions not shown in Figure 2.5 are hazardous waste items, such as leftover
paint, contaminated cleaning solvent, sandblasting grit and rags, contaminated personal protective
equipment, air filters, and paint-saturated rags, wipes, and masking materials.

Cantonment Activities

The tactical vehicle fleet and most administrative vehicles require gasoline or diesel fuel. The installation
operates two service stations. Fuel is stored in underground or aboveground tanks and dispensed through
commercial or industrial delivery systems. All together, these storage and distributing systems contributed a
total of 43.48 tons of volatile organic compounds and 3.61 tons of hazardous air pollutants to the atmosphere
in 2001, although gasoline stations were a far greater contributor than storage tanks (Figure 2.6).
Tank trails, haul roads to landfills, and troop construction yards are typically unpaved and can cause
particulate matter to disperse into the air. Vehicles emit carbon monoxide, nitrogen oxides, and hydrocarbon
products. Storage piles and haul roads contributed 29.27 tons of particulate matter to the

air in 2001.
Spreading, removal, and reclamation of landfill materials can cause the release of hazardous air pollutants
(0.64 tons in 2001) and volatile organic compounds (6.41 tons in 2001). Vehicles used to move the material
around also emit pollutants as described in the paragraph above. In April of 2002, landfill operations ceased,
and the landfill is now in the closure process. Discontinuing landfill-related activities will reduce the
Installation's contribution of hazardous air pollutants and volatile organic chemicals from this particular
source. However, transportation of trash off-site for disposal will have associated air impacts.

Figure 2.6 – Major Sources of Air Pollution from Cantonment Activities

Training Activities

Fort Carson's mission is to make soldiers combat-ready. A realistic training environment is critical to the
success of military operations and the survival of military personnel. There are many sources of air pollution
from training activities (Figure 2.7). Prescribed burns—scheduled, controlled fires that minimize the risk of
wildfires—release pollutants, but increase the number of training days because wildfires stop training and
cost tremendous manpower, time, and money to contain. (The Lands section contains more information on
prescribed burns.)
Soldiers must be transported to Piñon Canyon Maneuver Site, and once there, must have the ability to train
in a manner that simulates war situations. Due to the area's climate, topography, soil type, and vegetation,
training activities at both Fort Carson and the Piñon Canyon Maneuver Site result in fugitive dust (particulate
matter) emissions. However, it is in the best interest of a military unit to minimize the amount of dust, as
dust in the air gives away positions to "enemy" units during training and in war situations. Dust suppression
costs a minimum of $50,000 per year at Fort Carson and Piñon Canyon; the estimated annual cost to
suppress dust from all Fort Carson activities is $300,000.
Smoke and obscurants are used on the battlefield and in training to limit the enemy's visibility. Smoke and
obscurants are fast, low-cost countermeasures to enemy surveillance and weapons systems, such as infrared,
radar, and visual sensors. Practice in the use of obscurants is critical to battlefield

survival.
Excess, obsolete, or unserviceable munitions and explosive materials must be destroyed. Allowing these
materials to accumulate can cause serious hazards. Open burning and open detonation are allowed in Fort
Carson's Air Operating Permit.

Figure 2.7 – Major Sources of Air Pollution, Flow, and Impacts from Training Activities

The Human Perspective

Fort Carson has made advances in reducing air pollution. Nevertheless, critical equipment such as
emergency generators and life-saving materials such as chemical agent resistant coatings are necessary for
the Installation to accomplish its mission. Technologies are available to accomplish dramatic reductions in
air pollution from several activities. Unfortunately, the costs for these technologies are high. Funding is also
needed for research into less polluting methods, machinery, or substances.
The Environmental Protection Agency designated Colorado Springs as an "Attainment/Maintenance" area
for carbon monoxide levels on October 25, 1999. Attainment was accomplished through the joint efforts of
the State of Colorado and Colorado Springs through a State Implementation Plan (SIP). The SIP specifies
how state and local governments plan to achieve and maintain air quality that meets health-based standards.
However, the area remains on the margins of attainment and only a few more emission sources will be
required to return the area to nonattainment status. Under the General Conformity Rule, Fort Carson is
required to address any new emissions of carbon monoxide from new sources and new construction by
documenting if the activity or source will significantly contribute to increased carbon monoxide emissions
within the Colorado Springs maintenance area.

Beyond the Pikes Peak Region

When soldiers train at other Installations or in foreign battlefields, they know that little or no footprint must
be left, or the enemy will discover their position. This care translates into minimizing dust during movement
and using obscurants when operations and maneuvers require secrecy. Furthermore, good stewardship
practices must be employed to ensure that foreign lands will be left with as little environmental damage as

possible. The use of back-up generators, vehicles, and obscurants creates air pollutants that can be
transported significant distances. Minimizing these impacts with better practices, materials, or technologies
will become increasingly important as countries tighten restrictions on military vehicles and maneuvers in
and through their territories.

Forecast

As one of the fastest growing regions in the country, the Pikes Peak Region faces challenges concerning
population growth, land use, transportation, and air quality. Communities within the region have the
potential to affect Fort Carson directly because deterioration of regional air quality will result in more
stringent regulatory and permit restrictions. The restrictions may influence future military training and other
Installation operations.
The recent expansion of the Interstate 25 corridor in Colorado Springs cost millions of dollars. Mass transit
improvements were not included, although the Pikes Peak Area Council of Governments is developing a
“Destination 2025 Plan,” which addresses long-term transportation issues in the region. Fort Carson's
participation in long-term planning efforts is critical to the development of a sustainability partnership with
the surrounding communities.

In 1999, the oxygenated fuel program was relaxed in El Paso County, making it a contingency measure
instead of a control measure. Oxygenated fuels reduce exhaust emissions by enhancing combustion. This
relaxation of requirements was due, in part, to the area’s level of carbon monoxide emissions falling within
Federal standards limitations. A University of Denver study claimed that one-half of the carbon monoxide
emissions came from the 10 percent of cars on the road that need a tune-up. The study recommended that
those emissions be addressed by requiring tune-ups instead of requiring the use of oxygenated fuels
(http://216.239.51.100/search?q=cache:l7HAN0NRcYIC:www.fortfreedom.org/k37.htm+oxygenated+fuels+
cost&hl=en). Fort Carson should contribute in future decision-making activities that will affect the types of
fuels allowed in the area.

Current Sustainability Activities

- **Natural Gas Boilers** – The Directorate of Public Works is working to replace all fuel-oil boiler systems
with cleaner natural gas systems.
- **Environmentally Friendly Parts Washers** – The DECAM is developing a program to replace parts
washers that use Stoddard solvent with parts washers that use a more environmentally friendly solvent.
This project also incorporates servicing the systems and recycling the solvent, which saves money.
- **Dust Suppression Program** – Fort Carson is working to develop better dust suppression methods that
use magnesium chloride.
- **High-Volume, Low-Pressure Paint Guns** – High-volume, low-pressure paint guns reduce over-spray
by providing a higher volume of air under lower pressure for greater control. The Directorate of
Logistics uses several of these paint guns in their primary paint booth at Building 8000.
- **Environmental Protection Officer Training Program** – The DECAM developed an intensive 40-hour
training program, which includes ways to reduce air pollution, to address all on-site environmental
issues.
- **Inspection Program** – Compliance Assistance Officers conduct both scheduled and unscheduled visits
to each motor pool on post to ensure that compliance issues are addressed and that simple management
practices, such as closing solvent tank lids, are implemented to help reduce air emissions.

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. Toward this end, 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

- **Field Photovoltaic System** – The 504th Parachute Infantry Regiment, 82nd Airborne, has developed and
tested a mobile photovoltaic system capable of providing up to 80 percent of the power required by a
modern tactical operations center. Use of this system would remove the need for dirty

diesel generators
and improve air quality in and around installations.

- **Tactical Alternative Fuel Vehicles (AFVs)** – While alternative fuels are not currently approved for use
in tactical vehicles, advances in technology may someday allow our tanks and armored personnel carriers
to run on biodiesel, compressed natural gas, or fuel cells. Beyond the obvious benefit to air quality,
moving toward the use of alternative fuels may also have operational benefits. Biodiesel, which is
produced from refined vegetable oils, is one of the few truly renewable domestic fuel sources. Vehicles
using biodiesel would be immune from variations in foreign oil supply.

- **Alternative Obscurants** – The U.S. Army Environmental Center has determined that certain types of
signal smoke grenades and smoke pots may be releasing toxic substances that could endanger soldiers
and the environment. The research indicated that dyes in the hexachlorethane smoke pots could be
carcinogenic. As a result, a project is underway to develop and test alternative obscurants with less toxic
characteristics. If successful, these new dyes would increase soldier safety while decreasing training
restrictions implemented to protect surrounding communities. Go to this web site for more information:
http://www.estcp.org/projects/pollution/200122o.cfm.

Energy Use

- **Microscopic Energy and Cleanup Systems** – Scientists at the Pacific Northwest National Laboratory
(PNNL) and other laboratories are developing a family of microscopic energy systems that are
manufactured in much the same way that computer chips are made. Microscopic heat exchangers,
evaporators, condensers, gas absorbers, turbines, bioreactors, chemical reactors, chemical separators,
pumps, and valves exhibit extraordinary rates of heat and mass transfer. When combined into heating,
ventilation, and air conditioning (HVAC) or process equipment, this translates into very high efficiencies

CFLs Microscopic Energy Systems
EnergyStar Drainwater Heat Recovery 100% Distributed Power
Dessicant Cooling Systems
Spectrally Selective Windows
Fuel Cells
Superconductivity
Solar Wind Geothermal
Field Photovoltaic
Tactical AFVs

and minimal pollution generation. These miniature components can be combined to create small heat pumps that can be integrated into window frames, with simple, plug-in replacement units if the originals fail. Small, biofueled fuel cells will be developed and can be located wherever heat and electricity is needed. Miniature chemical separation units will be developed for *in situ* cleanup of tanks, wells, aquifers, and other polluted systems—imagine a pen-sized device that can be dropped into a drum of waste to eliminate PCBs.

- **Drainwater Heat Recovery** – It is estimated that up to 80 percent of water-heating bills come from shower/bath water. An innovative technology called drainwater heat recovery uses the latent heat in drainwater to "preheat" cold water before it is sent through a conventional water heater. Drainwater is typically 90 to 95°F when it is piped away from the shower or bath, and 100 percent of that potential energy is wasted. These systems take heated drainwater and run it through tiny spiraling pipes to preheat cold water to a higher temperature, thus reducing the total amount of energy a water heater must expend to heat fresh water. Installing a drainwater heat recovery unit can reduce overall heating bills by as much as 40 percent. USEPA estimates that if 6 million hot water systems were outfitted with drainwater heat recovery systems, carbon dioxide emissions could be reduced by 20 million tons a year (http://www.oikos.com/gfx/index.html).
- **Superconductivity** – Superconductivity, the ability of a material to conduct electricity with zero resistance and almost no loss of power, is a cutting-edge technology that may some day revolutionize the way we think about electricity (http://www.eren.doe.gov/superconductivity/). Today, almost 10 percent of all electricity generated is lost in transmission—radiated as heat from inefficient copper and aluminum wires. Superconductors will lead to the development of a number of new technologies:
  - Transmission wires will carry 100 times more current on a wire no bigger than those currently in use.
  - Super-efficient mass transit systems (similar to the MagLev train in Japan) will transport people

at enormous speeds using a fraction of the energy used by current commuter trains.
- Electric motors using superconductor wiring will operate at a fraction of the cost, improving
industrial and residential energy efficiency while saving money.
- Electric generators will be smaller and lighter and require less fuel to generate power.

- **Compact Fluorescent Lights (CFLs)** – There are a number of commercially available alternatives to
traditional incandescent lights. Compact fluorescent lights use 50 to 70 percent less power than
incandescent lights of the same intensity. EPA maintains a comprehensive list of CFLs (http://www.energystar.gov/products/cfls/).
- **EnergyStar** – EPA maintains a database of high-efficiency appliances and office equipment. By simply
investing in these readily available alternatives, businesses and homes can save hundreds in energy bills
every year (http://www.energystar.gov).
- **Desiccant Cooling Systems** – Within the next few years, desiccant cooling systems could save offices
and large commercial buildings thousands of dollars per month in electricity bills (http://www.nrel.gov/desiccantcool/tech.html). Used in conjunction with traditional HVAC units,
desiccant coolers remove moisture from the outside air, cooling it in the process, which allows for much
higher efficiency for the primary cooling unit.

- **Spectrally Selective Windows** – Spectrally selective and chromogenic windows represent the next
generation of windows technology. Spectrally selective windows have advanced coatings that filter
certain wavelengths of radiation from the incident sunlight, significantly lowering overall solar heat gain.
Chromogenic windows are even more advanced, with coatings that change their reflective properties
based on ambient temperature or light conditions. Some estimates place the potential energy savings at
40 to 70 percent for electrically heated spaces.
- **Solar, Wind, and Geothermal** – Many Army installations are experimenting with renewable energy
sources such as geothermal, solar, and wind, which generate no air emissions. Fort Bliss is doing a
feasibility study on developing a wind farm to fulfill the majority of its electrical needs. Fort Hood and
Fort Irwin have installed “solargizers,” active daylighting of buildings, and solar-powered streetlights to
capture the sun’s energy. Fort Carson heats a hangar using a solar “wall” on one side of

the building.
For more information on the realm of possibility and examples of efforts world-wide, see Chapter 12,
Climate: Making Sense and Making Money, in the book Natural Capitalism.

- **Fuel Cells** – While fuel cells are starting to become available now, most industry analysts believe that it will be 8 to 10 years before they are truly cost competitive with traditional energy systems. These systems work by combining an ionized hydrogen fuel source with air to produce water and electricity. There are NO harmful emissions associated with their operation. They produce electricity that can then be used to heat and power a residence or office space. GE and other large energy services companies have invested millions in this technology and it is only a matter of time before we begin to use fuel cells in earnest (http://www.dodfuelcell.com/).
- **100 Percent Distributed Generation** – Distributed generation works on the premise that the most efficient way to produce electricity for a customer is to produce it at the location where it is needed, thus avoiding losses due to transmission. Imagine a country with no power lines, no polluting smokestacks, and no power companies as we know them today. Imagine instead a country where every home or office has a fuel cell in the basement generating electricity while releasing only water vapor as a byproduct. Or imagine an office building with a solar roof and windows that becomes a net source for power on sunny days. Impossible? Maybe so. However, as technology continues to develop, the day may come when every home and business can generate its own electricity for less than it costs now to buy electricity from a utility.

Transportation

- **Trees for Travel** – Trees for Travel is an organization that will plant trees to offset the pollutants caused by air and vehicle travel. Organizations can keep track of their mileage and send donations to Trees for

Travel. Large land-owning organizations, such as Fort Carson, can start their own

program to offset the
vehicle emissions caused by transportation activities (http://www.treesftf.org).

- **Voucher System** – The new Mass Transit Voucher System requires government agencies to pay up to
$65/month to cover the costs of employees who take mass transit or van pools to work.
- **Fuel Cell Vehicles** – Toyota and Honda will begin selling Fuel Cell Vehicles in 2003. Toyota Motor
Corporation will begin selling fuel cell motor vehicles in mid-2003, possibly becoming the first world
automaker to start selling next-generation automobiles. Because of the limited availability of hydrogen
for fuel and maintenance personnel for the new vehicles, Japan's No. 1 automaker initially expects to sell
only about a dozen fuel cell vehicles—in the Tokyo metropolitan area alone—primarily for use by
government offices and leading businesses. A Toyota spokesman confirmed that the company is
preparing to launch the vehicle "at the soonest possible time of next year," which is expected to be based
on its experimental model, the FCHV-4, and mounted on a sport utility vehicle. The Kluger V. Honda
Motor Company is also gearing to launch its own fuel cell model for limited commercial sales next year.
DaimlerChrysler Corporation and Ford Motor Company are preparing to launch fuel cell cars in 2004.
Fuel cell vehicles, which are powered by hydrogen stored in an onboard, high-pressure tank, emit no
harmful pollutants into the air at the point of use (BNA, Feb 2002).
- **Alternative Fuel Vehicles (AFVs)** – The General Services Administration (GSA) provides vehicles that
run on alternative fuels, such as natural gas, propane, and electricity. These vehicles have reduced air
emissions. Honda, Nissan, and Ford also have alternative fuel vehicles on the market. Fueling stations
are needed to make this a viable option on a widespread basis.
  - Acrion Technologies, Inc., developed a method to capture methane from landfills by condensing it to liquid form, vaporizing volatile organic compounds, and using the clean, high-grade fuel that is left for boilers, turbines, or fuel cells.
  - The U.S. Army Research Laboratory Coatings Research team has developed a formulation
with a lower volatile organic compound content. This formula, if fully implemented, could
reduce volatile organic compound emissions by approximately four million pounds per year
(https://www.denix.osd.mil/denix/public/library/PRO97/wrcarc.html). This technology is available now.

- **Hypercar** – Rocky Mountain Institute (RMI) developed a concept design for a "hypercar" and put it in the public domain in the early 1990s. By reconfiguring three key design elements, RMI estimates that 70 to 80 percent of the fuel could be saved, which corresponds to a decrease in air emissions, while making cars safer, sportier, and more comfortable. The three design elements include 1) making the vehicle ultralight by using composites instead of metal, with a weight two to three times less than steel cars; 2) making the vehicle more aerodynamic, so it has much less drag; and 3) making the vehicle's propulsion system hybrid-electric, with the electricity produced on board from fuel as needed. The fuel could be conventional gas or diesel, or a stack of fuel cells, which turn hydrogen and air into electricity. From 1993-98, the private sector committed roughly $5B to developing the hypercar. The major automakers have built prototypes and predict mass production of fuel cell powered cars by 2005; Honda and Toyota already have hybrid-electric vehicles on the market in Europe, Japan, and the United States.

Product Selection and Use

- **Solvent-free Degreasing** – The Army Tank-automotive and Armaments Command (TACOM) and the Army Research Laboratory are testing and evaluating new technologies for solvent-free degreasing. Ideally, the technology will be available within two to five years.
- **Alternative Cleaners** – Many different cleaning agents are available to reduce the use of hazardous air pollutants and ozone-depleting chemicals. Common alternative agents range from water-based to petroleum distillates. A new class of plant-derived cleaners began to emerge in the last decade. Terpenes derived from citrus oils are the most noted of this class. Recently, other plant-derived cleaners have been developed. These include the ethyl lactate-based cleaners derived from corn and soy (http://www.gemtek.com). Plant-derived cleaning agents can be used over a wide range of cleaning applications, from clean room applications to general maintenance.
- **Decreased Paint Emissions** – The Army Corps of Engineering Research Laboratory has developed a cartridge-like device that captures hazardous air pollutants and volatile organic

compounds exhausted
from painting and chemical cleaning operations, and recycles them for reuse as paint thinners. Available
now, this system saves money by eliminating three steps in the filtering process and results in emissions
that fall well under regulated levels.
The same lab has also developed a mobile zone system for painting that concentrates the volatile organic
hazardous air pollutants from painting activities. Pollutants are reduced by recirculating ventilation in a
spray booth in conjunction with a mobile, partially enclosed space for the painter. The airflow across the
worker is improved while the treated volume of air in the paint booth is reduced from 30,000 cubic feet
per minute to 2,000 cubic feet per minute, concentrating and reducing the volume of captured pollutants.

Fort Carson 25-Year Goals for Air Quality

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.

Solvent-free Degreasing
Alternative Cleaners

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