Fort Bragg Environmental Baseline

Sustaining Fort Bragg Through Transformation: Phase I

Prepared by

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Sustaining Fort Bragg Through Transformation: Phase 1

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Message from the Garrison Commander

In a 4 December 2000 letter, the Secretary of the Army challenged the participants in the first Army Worldwide Environmental & Energy Conference to strive towards a common vision of sustainable installations:

> ***"The goal is to map out a new vision for the management of our installations, a holistic approach to sustaining our installations well into the 21st Century while simultaneously fostering transformation…***
>
> ***Installation commanders will need to integrate the critical components of energy and natural resource management, construction, procurement, and environmental protection for our long-term success…***
>
> ***Our installations must be fully functional now, thirty years from now, and well into the next century. This means we must not deplete our irreplaceable resources and must also reduce our polluting emissions as much as possible…***
>
> ***The land resources we depend on for training and testing need to be fully accessible and utilizable, and we must protect the invaluable natural resources entrusted to our care as jealously as we do the freedom that Americans entrust us to safeguard."***

The mission from the Army leadership is clear: we must ensure that Fort Bragg functions well as a power projection platform now—25 years from now—and beyond. We must manage our resources to support the present mission – without compromising our ability to accomplish the mission in the future.

Fort Bragg directly "touches" 65,000 soldiers, families, and civilians that live or work on the installation, and 146,000 retirees and dependents who live within a 50 mile radius. It is the Army's premier power projection platform, capable of supporting our national defense needs anywhere in the world within 18 hours of notification.

In terms of natural, cultural, and historical significance, this place—where we live, work, and train—is precious real estate to us, the Army, and the nation. We derive our living from this land; but, more importantly, it defines us: our values, our history, and the ultimate legacy that we leave behind for future generations to build upon. Our responsibility to those future generations requires us to sustain our resources through wise stewardship, conservative management, and cooperative regional planning. This is the proud legacy that must define Fort Bragg now and well into the future.

Tough challenges confront us in our quest to sustain this legacy into the 21st century, and to leave a positive legacy for future generations. Each of these challenges will require the integration of sound economic principles, mission focus, and environmental stewardship. Sustainability harkens back to before the U.S. industrial revolution—when waste was unacceptable and all capital, including natural capital, was precious. This document outlines those challenges.

Message from the Garrison Commander

At our Environmental Sustainability Executive Conference, which will take place 17-18 April of this year, we will bring together Fort Bragg, FORSCOM, the Department of the Army and members of the local and regulatory communities. At this conference, we will set 25-year goals for addressing these daunting challenges and we will identify those who must be part of the community solution. We must recognize the importance of both our needs and our responsibilities as regional citizens—as well as those of our partners.

It will not be easy to meet these challenges. The effort will require commitment and cooperation across environmental, facilities, procurement, and operations staffs. Nor will we succeed without the vigorous participation and support of our neighbors, our headquarters in Atlanta and Washington, and our partners in state and federal agencies. My charge to you is this: examine the issues set forth in this document; determine the end state we want to achieve; set aggressive, attainable, and quantifiable goals; and pull together teams that engage the right stakeholders to ensure that Fort Bragg's history of proud service to the nation, and the world, continues indefinitely.

Addison D. Davis, IV
Colonel, U.S. Army
Garrison Commander

Executive Summary

Our Sustainability Challenges Include:

Use of energy at Fort Bragg, whether it's generated on post or off, contributes to the high levels of ozone in the air. Further, the events this winter in California and across the nation raise serious concerns about the cost of energy and the availability of energy at ANY cost. How can Fort Bragg protect and secure the energy it needs to operate?

Facility construction, operation, maintenance, and demolition is costly, leading to numerous environmental impacts and large energy and water use. How can Fort Bragg provide the world-class facilities that soldiers and families deserve, while minimizing associated pollution, resource depletion, and costs?

The state of North Carolina is increasingly concerned about ozone and other air pollutants. How can Fort Bragg minimize future costs and operational restrictions while improving regional air quality?

Potential sources of water for Ft Bragg consumption have been steadily declining (both in quantity and quality) due to overuse. How can Fort Bragg reduce its dependence on these sources and provide premium quality drinking water as well as the "right" quality water for other uses, without aggravating future regional water supply issues?

Contamination of regional water resources, particularly by sediments, is a critical consideration to North Carolina, because of the economic impacts associated with destruction of fish habitats, treatment of water to drinking quality, and the decrease of drinking water reservoir holding capacity. How can Fort Bragg minimize the future costs and potential operational restrictions associated with water pollution, while improving regional water quality?

Fort Bragg buys $176M worth of products and materials every year—and throws away over 200,000 tons at a total cost well over $3M. How can Fort Bragg promote the sustainable manufacture, use, and disposal of materials and products, while minimizing costs and environmental impact? How can Fort Bragg stimulate local and national markets for environmentally preferred products?

Fort Bragg maintains 161,597 acres of land for training. Of this, only 72,236 acres are unrestricted for use. How can Fort Bragg provide enough usable land for military training—and ensure that training is not further constrained by concerns over potential environmental contamination and negative impacts on endangered species? How can Fort Bragg use its land requirements to address the effects of urban sprawl and regional needs for open space and biodiversity?

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Energy Use

Challenge: Use of energy at Fort Bragg, whether it is generated on post or off, contributes to the high levels of ozone in the air. Further, the events this winter in California and across the nation raise serious concerns about the cost of energy and the availability of energy at ANY cost. How can Fort Bragg protect and secure the energy it needs to operate, while improving regional air quality and controlling costs?

Introduction:

The Public Works Business Center (PWBC) operates Fort Bragg's energy provision and conservation program. Installation operations consume 3 million MBTU/year of energy in the form of electricity, natural gas, and heating oil, at a cost of almost $30M/year. Figure 1 shows total energy consumption and costs for FY 95 – FY 00.

The Carolina Power and Light Company (CP&L) provides the bulk of electric power directly to the cantonment area and Camp Mckall. There are four substations on Fort Bragg: the Main substation, Woodruff

Importance to Fort Bragg

Mission – Reliable, affordable energy is essential to Fort Bragg's continued operation.

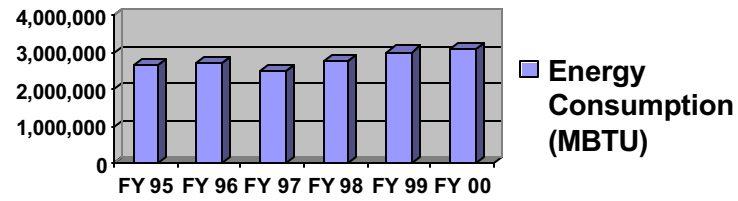
Quality of Life – Good QOL depends on sufficient heat, hot water, air conditioning, and clean air.

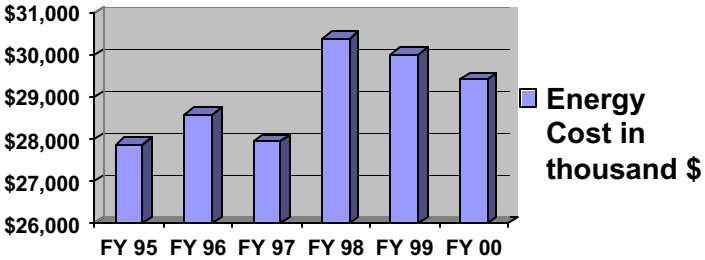
Cost – Annual total energy cost is approximately $29M/year, of which $23M is spent on electricity and $6M is spent on natural gas for heating. This cost represents 20 percent of the installation's base operating budget.

Environment and the Community – Total energy use at Fort Bragg for FY 00 resulted in the generation and release of 378,143 tons of CO_2; 1,118 tons of NO_X; and 2,461 tons of SO_X into the air. These quantities are based on standard calculations for converting energy used per kWh to emissions produced. The CO_2 and NO_X combine with sunlight to cause high ground levels of ozone, putting Fort Bragg and the local community in a designated ozone nonattainment area. Use of energy at Fort Bragg, whether it is generated on post or off, contributes to the high levels of ozone in the air. High ozone levels cause respiratory problems.

Fort Bragg received two environmental enforcement actions in FY 00 for improper start up and operation of boilers.

Figure 1 - Key Energy Data (Use and Cost)





Energy Use

substation (new Womack only), Knox Street substation, and Longstreet substation. Electric consumption is currently measured through five main meters, resulting in one total bill to the installation. In FY 00, the peak electric demand was 320 MBTU, and annual electric use was 1,710,621 MBTU, which resulted in a total cost of $23M.

Prior to March 2000, North Carolina Natural Gas Company (NCNG) provided the bulk of Fort Bragg's natural gas requirements. Fort Bragg has one delivery point for natural gas located on the installation boundary behind the Knox Street warehouses. Since March 2000, Fort Bragg has used open market purchasing for natural gas and an additional fallback contract with the NCNG. This allows the installation to purchase natural gas at optimal prices. In FY 00, the installation used 1,389,077 MBTUs in the form of No. 2 fuel oil and natural gas, at a cost of $6M, which has been included in Figure 1.

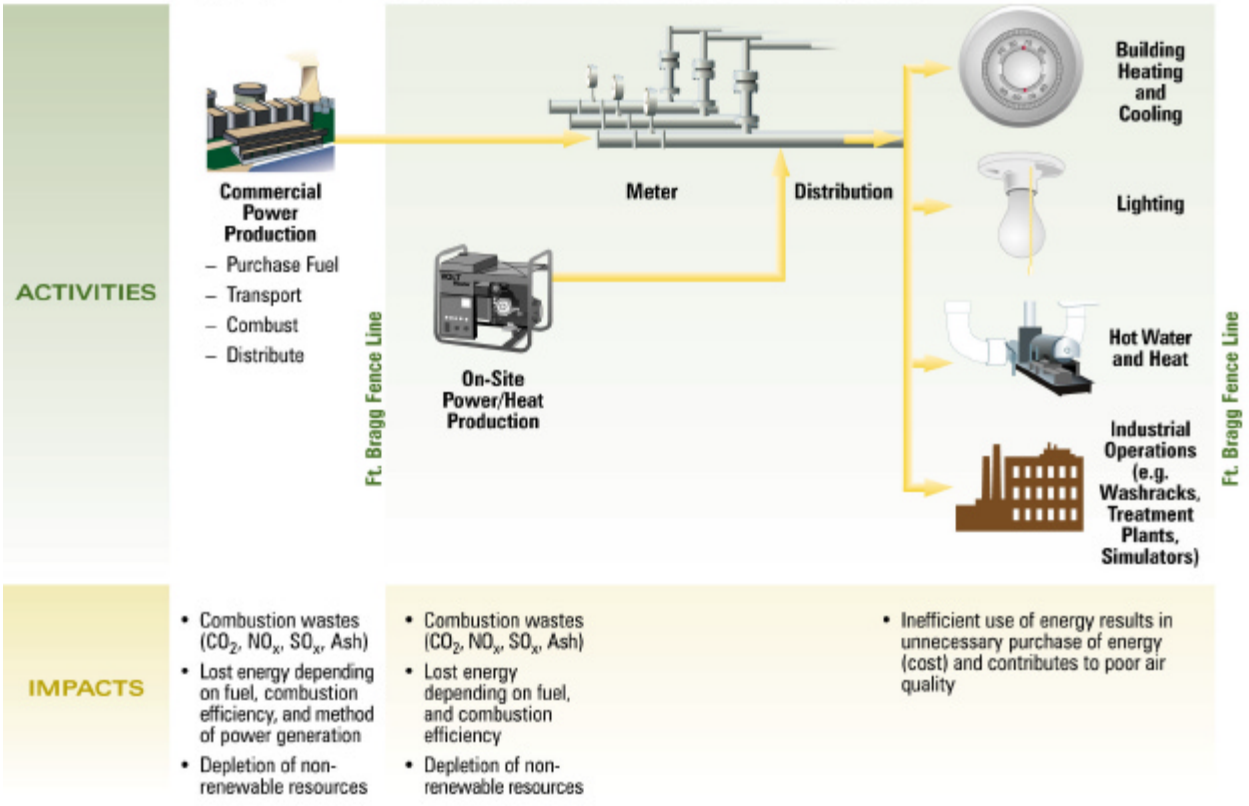
Though consumption of both gas and electricity is inching upwards, cost dropped a total of $1M between FY 98 and FY 00. Ongoing construction and expansion of real property led to a net increase in energy consumption. Decrease in cost was realized through implementation of real-time pricing by the installation. Future decreases in energy consumption and cost are expected through use of energy efficiency and real time pricing task orders implemented by Honeywell in the Energy Savings Performance Contract tgpartnership (see the Activities/Impacts section for details).

Activities/Impacts:

Energy is critical to the accomplishment of Fort Bragg's mission. Figure 2 provides an overview of the types of activities that require energy and their subsequent impacts.

Energy Use

Figure 2 – Energy Use: Activities and Impacts

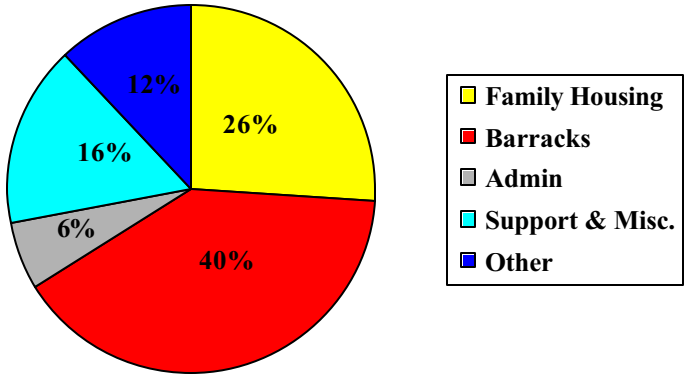


Fort Bragg predominantly uses its energy for facility and residential lighting, air conditioning, heating, and industrial operations. Facility energy use by building type is shown in Figure 3. The chart shows where the most impact can be made in energy conservation and awareness programs—the housing areas.

Forecast:

Energy use may be a future issue as the surrounding population grows and consumption increases. Another potential future issue is deregulation within the energy industry that may take place in North Carolina. As is the case in California, deregulated energy production could result in service variance and high cost.

Figure 3 – Energy Consumption by Building Type



Energy Use

Conservation is one option for ensuring availability of energy and stable costs. Since 84 percent of energy use at Fort Bragg is related to building operations, better control of building energy could significantly reduce consumption rates.

Existing Buildings

Projections of potential energy savings at Fort Bragg were made using the Renewables and Energy Efficiency Planning (REEP) system, which was developed at the U.S. Army Construction Research Laboratory. Applying the energy conservation measures identified in Figure 4 to current facilities, the REEP model projected the potential to reduce energy use by 1.43 million MBTU/yr, or 46 percent. Such reductions in power use could result in annual cost savings of more than $16M for an investment of $59M. As energy use is reduced, emissions of carbon monoxide and dioxide, sulfur and nitrogen oxides, and hydrocarbons resulting from power production will also be reduced. Figures 5 and 6 summarize the reductions in energy consumption and pollution that could be achieved. Appendix A provides detailed output for Fort Bragg generated by the REEP model.

Figure 4 – Energy Conservation Measures Recommended by REEP Model

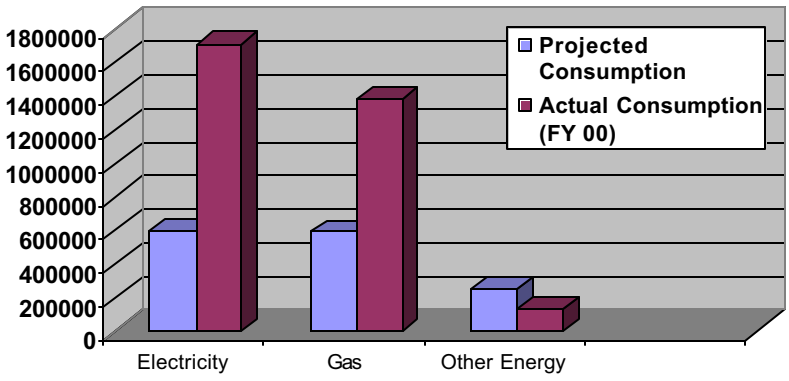
Water Heater Insulation Blanket ☑
Window Insulation ☑ (80 percent complete)
HVAC Controls ☑ (ongoing)
- EMCS/DDC

HVAC
- High Efficiency Gas Boilers
- Ventilation Heat Recovery
- Enthalpy Recovery Dessent Wheel
- High Efficiency Ventilation Motors

Lighting
- Fluorescents (4' and compact) ☑
- High Pressure Sodium Lights-In
- High Wattage Incandescent Replacement ☑
- Occupancy Sensors ☑

☑ Currently underway at Fort Bragg

Figure 5 – Projected Annual Reduction in Energy Consumption (Mbtu/Yr) (REEP MODEL)



Projected reductions in energy consumption total 1,434,600 MBTU/year

Figure 6 – Projected Pollution Reduction (Tons/Yr) (REEP MODEL)

	Tons/Yr Reduction	%
CO2	193,618	28
SOx	1,411	30
NOx	546	26
Particulates	72	--
CO	35	--
HC	3	--
Total	**195,685**	

-- Data on past emissions is unavailable.

Energy Use

New Construction

Fort Bragg plans to do $1.5B worth of new construction over the next seven years. According to the Rocky Mountain Institute, currently available technology such as super windows and super insulation can reduce the energy demand in residential/commercial construction at little or no additional first cost. This technology can reduce energy demand by 80 percent compared to typical 1970's construction technology. Rocky Mountain Institute's headquarters, built in 1984 in Snowmass, Colorado, where winter temperatures can be as low as 47 degrees below zero, has a heating bill of about $5/month.

Current Activities that Address Energy Use:

In 1997, Fort Bragg began a partnership with Honeywell under an Energy Savings Performance Contract (ESPC) through the Huntsville Division of the Army Corps of Engineers. The ESPC partnership is intended to meet the requirements of Executive Order 13123, which requires a reduction in energy consumption of 35 percent by 2010 compared to the 1985 baseline. The ESPC contract is a 25-year contract that guarantees energy efficiency and cost savings based on Honeywell's performance. Honeywell assumes all risk and start-up costs, and the savings realized through energy efficiency projects are then reinvested in the installation's infrastructure. Honeywell has already invested $40M in the installation through this contract. Savings from the investment are split between the installation and Honeywell, with up to 10 percent going to the installation and 90 percent going to Honeywell to repay capital investments.

To date, 20 projects have been awarded and 13 have been completed. The first project was a small lighting project at Simmons Army Airfield (SAAF) that resulted in an energy savings of 1,416 MBTUs and a cost savings of $28,829 over the first year. Over the life of the project, savings are projected at 26,630 MBTUs in energy and $541,984 in cost. Another lighting project at the 82d resulted in a savings of five megawatts/day after replacing 177,000 incandescent light bulbs with T-8 fluorescent bulbs that have occupancy sensors and electronic ballasts (which will now be maintained by Honeywell). Figure 7 provides a summary of results for each task order completed to date and estimated energy savings over the life of the ESPC contract.

Energy Use

Figure 7 - Summary to Date

Task Order (Project)	Total Estimated Energy Reduction Over 25 yrs (MBTU)	Total Energy Reduction to Date (MBTU)	Total Cost Savings to Date
TO1 SAAF Lighting	26,630	1,416	$28,829
TO2 SAAF Mechanical	1,406,352	61,146	$908,882
TO3 Officers Club	88,781	4,129	$67,066
TO4 JSOC	132,965	7,938	$149,924
TO5 82d Lighting	402,288	21,360	$603,673
TO6 Demo Lighting	43,681	6,240	$136,800
TO7 Knox Street	247,306	6,240	$132,421
TO8 A-Area VMF	367,219	17,487	$95,975
TO9 NCO Club	52,409	780	$22,373
TO10 C-Area VMF	307,126	15,356	$84,915
TO11 Old Womack	740,056	Not Occupied Yet	Not Occupied Yet
TO12.1 Natural Gas	NA	NA	$188,935
TO12.2 Load Mgmt & RTP	NA	NA	$3,285,106
Total	3,074,756	148,588	**$5,704,899**

In addition to the projects listed above, Fort Bragg is also installing 350 meters across the installation for real time monitoring of energy use through the ESPC contract. Although the installation does not currently generate any of its own power, there are two current proposals for power generation projects under the ESPC contract. Within the next year, Fort Bragg hopes to implement plans to produce up to 20 MKW/day for peak shaving and emergency generation. These proposals include use of up to 21 individual generators for peak shaving and construction of a synthetic natural gas plant capable of supporting the installation's energy needs for up to seven days in emergency situations.

To date, more than $5,700,000 has been saved annually by ESPC projects. An estimated net savings approaching $98,000,000 (or approximately $5.36 million/year) over the life of the contract is expected. As an added benefit, ESPC projects have also resulted in a net reduction of 1,347 tons of monitored air pollutants—equal to the lifetime removal of 403 automobiles.

Energy Use

Combining ESPC projects with utilities privatization upgrades can also further benefit Fort Bragg. An agreement is already in existence between the installation, Honeywell, and the utility contract bidders.

The Realm of Possibility:

- The U.S. Green Building Council's release in 2000 of the Leadership in Energy and Environmental Design (LEED) rating system provides a national standard for evaluating and comparing green building performance, of which energy use is an important part. The LEED standards can be downloaded from the Council's website at www.usgbc.org.
- Fuel cells turn hydrogen and air into electricity and nothing else—no harmful emissions. DoD currently has a program for evaluating the use of fuel cells on military installations. Of course, production of the hydrogen requires the burning of conventional or alternative fuel somewhere, but at the point of use, no air pollution is emitted.
- Rocky Mountain Institute developed a concept design for a "hypercar" and put it in the public domain in the early 1990s. By reconfiguring three key design elements, they estimate that 70-80 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 ultra-light, with a weight 2-3 times less than steel cars, by using composites instead of metal; 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 and generate no harmful emissions. 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 have hybrid-electrics on the market in Europe, Japan, and the U.S. already.
- Intense speculation is surrounding the 2002 promised release of entrepreneur and inventor Dean Kamen's latest invention, referred to as "IT". Journalist-author Steve Kemper says the invention will "sweep over the world and change lives, cities, and ways of thinking." Kamen says that IT will provide an alternative to devices that "are dirty, expensive, sometimes dangerous, and often frustrating, especially for people in the cities." No one except a few venture capitalists know what IT really is, though many speculate that it is a pollution-free personal transportation device—which could reduce the air pollution and fuel use associated with the current transportation system.
- For more information on the realm of possibility and examples of efforts world-wide, see Chapter 12, Climate: Making Sense and Making Money, and Chapter 6, Tunneling Through the Cost Barrier, Natural Capitalism.

Fort Bragg 25-year Goals for Energy:

To be determined by Fort Bragg Command and staff, as advised by members of local and regulatory community, at the Environmental Sustainability Executive Conference on 17-18 April 01.

Energy Use

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Buildings

Challenge: Facility construction, operation, maintenance, and demolition are costly, leading to numerous environmental impacts and large energy and water use. How can Fort Bragg provide the world-class facilities that soldiers and families deserve, while also minimizing pollution, resource depletion, and costs?

Introduction:

Fort Bragg's infrastructure is large, diverse, and continually changing to meet current and future requirements. The Public Works Business Center (PWBC) is responsible for the design, construction, operation and maintenance, demolition, and ultimate disposal of the installation's buildings.

Fort Bragg operates and maintains 28M square feet of real property at an estimated acquisition value of $1.79B, which was the cost to the government at the time of purchase. The replacement cost for the installation's infrastructure would be significantly higher. In FY 00, the installation spent $75M on major construction projects and $55M on maintenance and repair. Figure 8 lists the types of buildings on Fort Bragg and associated square footage.

Importance to Fort Bragg

Mission – Adequate facilities for training soldiers and maintaining equipment are needed for mission accomplishment.

Quality of Life – Sufficient comfortable, suitable facilities for living, working, and training are a basic necessity for good quality of life.

Cost – 90 percent of the life cycle costs of facilities are for operation and maintenance. Annual O&M costs at Fort Bragg are $55M. FY 00 construction costs were $76M. The projected cost for future construction over the next seven years is $1.5B.

Environment and the Community – Construction of facilities requires large amounts of building materials, can cause erosion and water quality degradation, and limit recharge of aquifers. O&M requires hazardous materials and generates solid waste. Energy used to light, heat, and cool buildings generates air pollution. Demolition generates solid waste.

Figure 8 – Key Building and Structure Data

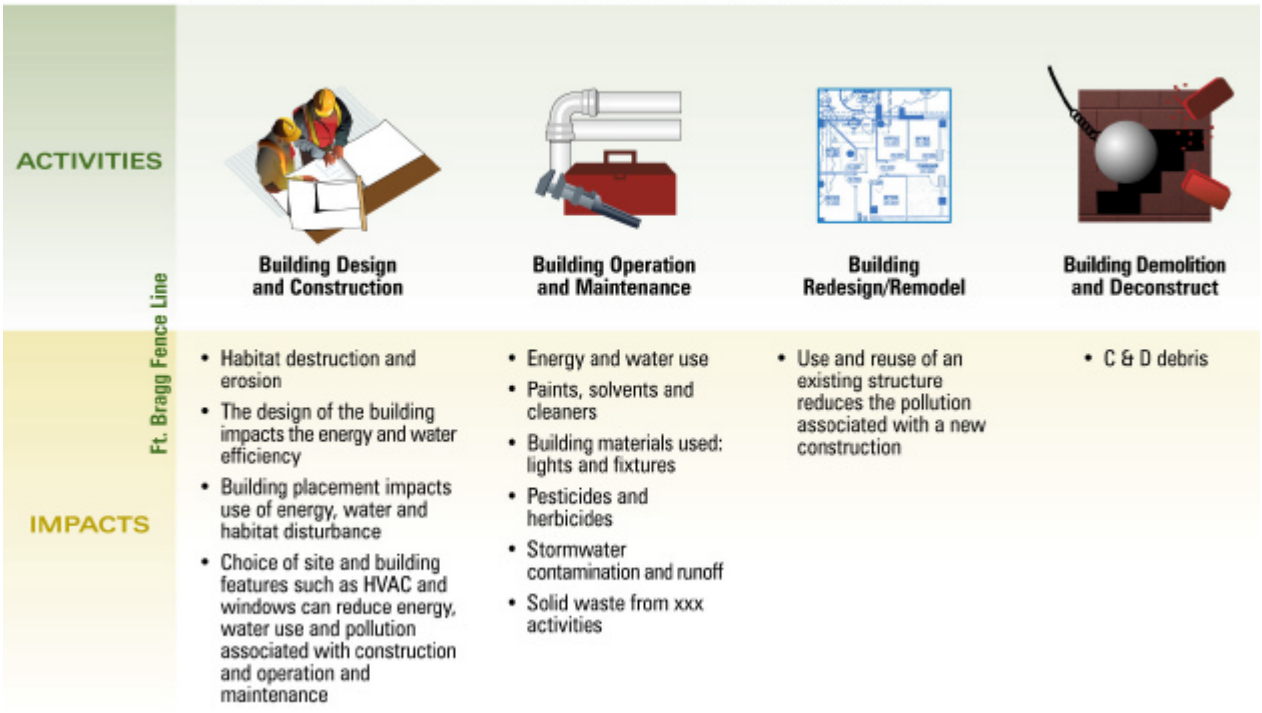
Type	Number	Ft^2
Barracks	195	4,826,890
Family Housing (26 neighborhoods)	4,739	7,807,624
- On-post (7,405,641 ft^2)	4,489	
- Off-post (401,983 ft^2)	250	
Storage/Depot	367	2,761,988
Maintenance (total)	161	1,843,347
Training	268	1,287,634
Community Facilities	183	2,374,271
Administrative	284	5,158,230
Medical	10	1,383,120
Utilities	2 (+ supporting structures)	210,894
Other		385,029
Total		**28,039,027**

Buildings

Activities/Impacts:

Several environmental impacts arise from construction, operation, maintenance, remodeling, and demolition of buildings. The placement and construction of buildings can damage habitat and create erosion. The design and construction (including construction material and equipment choices) will define the operation and the maintenance costs of the building, which are responsible for 90 percent of the total life cycle cost of a typical building. The operation of buildings results in energy and water use, hazardous materials for maintenance, and various solid wastes from maintenance, repair/replacement, and occupant activities. Construction, renovation, and demolition create debris (over 100,000 tons in FY 00) that is mostly landfilled. Figure 9 depicts the impacts associated with each of these activities.

Figure 9 – Buildings: Activities and Impacts



Building construction, demolition, and operation and maintenance activities can have the following negative impacts on the environment:

- Storm water – Fort Bragg currently has a problem with excessive storm water runoff and sedimentation resulting from the disturbance of easily eroded soils. The extent of the problem is not completely quantified at this time, but further construction and creation of impervious

Buildings

surfaces will undoubtedly increase negative impacts (see the Water Quality section for more detail on storm water impact). While a current standard of zero net increase in storm water runoff is in use for construction sites, it may not be enough to mitigate existing problems.

- Air quality – Fort Bragg spent $6M on natural gas and $23M on electricity in FY 00, which mostly went to lighting, heating, and cooling buildings. This resulted in the production of 380 tons of air pollutants, which increase the high levels of ground-level ozone. Fort Bragg and much of the surrounding region is classified as a nonattainment area for ozone. If Fort Bragg and the surrounding regions do not effectively control and reduce emission of ozone precursors from burning fuels for energy, future development could become more restricted as well as expensive (see the Air Quality section).
- Water use and sewage treatment – Fort Bragg's water consumption rates have been steadily climbing since 1992 without a change in the installation's population. Continued development and construction places an additional load on both the water treatment and waste water treatment plants. The waste water treatment plant is currently operating at 68 percent of its design capacity, and is expected to reach nearly 80 percent within the next three years (see the Water Supply section).
- Solid Waste – Construction and demolition (C&D) debris currently represents the largest component of the installation's solid waste stream. In FY 00, 21,500 tons of concrete were crushed into gravel and rip rap. Of the concrete crushed, 100 percent was reused by the installation. In addition, Fort Bragg is currently crushing concrete that arrives intact at the Lamont Landfill. The cost of crushing and reusing concrete is actually less than the cost of buying the same material at local market prices. There are currently no programs for asphalt, metal, wood, carpet, and fixtures, which also make up a large portion of C&D waste. Land clearing and inert debris (LCID) waste is currently the second largest component of Fort Bragg's solid waste stream. This material is composed mainly of yard cuttings, branches, untreated wood, and tree stumps. If shredded, this material serves well as filler for holes and depressions, and can also aid in soil stabilization. There are currently no programs for shredding or mulching. The bulk of LCID is disposed of in the installation's LCID landfill.

Figure 10 lists the tonnage and type of solid waste generated by the installation in FY 00, when Fort Bragg generated a total of 218,680 tons (437,360,000 pounds) of solid waste. Of that total, construction and demolition activities, mostly associated with barracks renewal, were responsible for 120,000 tons—more than half the total solid waste stream. Construction and demolition debris is currently the largest component of Fort Bragg's solid waste, followed by land clearing and inert debris, municipal waste, hazardous waste, and other types of solid waste.

Buildings

Figure 10 – FY 00 Total Solid Waste Generation (tons)

Type	Generated	%	Recycled	Disposed
Construction and demolition (C&D)	120,201	55	21,500	98,701
Land clearing and inert debris (LCID)	65,266	30	0	65,266
Municipal solid waste (MSW)	8,743	13	1,553	27,190
Hazardous waste (HW)	204	.09	0	204
Non-regulated waste	255	.16	222	33
Universal waste	18	.008	10	8
Other	3,993	1.82	3,993	0
Total	**218,680**	**100**	**27,278**	**191,401**

Forecast:

Over the next seven years, Fort Bragg will be investing over $1B in a post-wide barracks renewal project. The project is expected to occur through the year 2008 and is intended to replace the existing barracks in order to meet the Army standards for barracks quality of life. Over the life of this project, more than 2,242,222 square feet of barracks and administrative buildings will be demolished and subsequently rebuilt.

In addition, Fort Bragg will spend an additional $31,700,000 on family housing renewal over the next two years. The installation spent $40,600,000 in whole neighborhood renewal and revitalization projects from FY 98 to FY 00. Figure 11 summarizes the construction schedule and cost for projects through FY 02.

Figure 11 – Housing Renewal Projects through FY 02

Number of units	Start Date	Cost
112	FY 01	14.6 million
48	FY 01	7.4 million
64	FY 02*	9.7 million
Total	**Through FY 02**	**31.7 million**

* The project scheduled for FY 02 may disappear due to the Residential Communities Initiative (RCI).

Buildings

Fort Bragg is also participating in the Army's Residential Communities Initiative (RCI). RCI is an Army program designed to enhance quality housing by transferring ownership, maintenance, and operation of military family housing to large housing contractors through 50-year, lifetime contracts. This program is in the early stages of implementation; a feasibility study is currently being conducted at Fort Bragg. If considered feasible for Fort Bragg, family housing areas would no longer be designed, built, or maintained by PWBC.

Better design of buildings could provide Fort Bragg with many opportunities to reduce costs and environmental impacts. Any negative impacts created by new construction that are not appropriately addressed in the planning and design phase will become long-term costs for the installation. These cost would last 50 years for RCI initiatives and probably longer for buildings the Army continues to own. Each is described below:

- Resource Efficiency – The renovations of barracks and possible sale of housing units provide the opportunity to design and construct buildings that are energy and water efficient.
- Storm water – Existing problems with storm water runoff, erosion, and sedimentation will continue to worsen as impacts increase due to additional development on the installation. As motorpools are rebuilt beginning in FY 03, storm water best management practices (BMPs) and specific design techniques for limiting storm water impact need to be addressed. Phase II of the installation's storm water permit sets forth specific requirements for both industrial and residential areas (for more information on storm water permits see the Water Quality section). The current standard of zero net increase in storm water runoff for construction sites may not be enough to halt and reverse existing problems.
- Solid waste – The tonnage for construction and demolition is expected to increase over the next several years as the barracks renovation program continues through 2008. In the next seven years, over 97 barracks and associated buildings will be demolished and rebuilt. Over the life of the project, approximately 1.2M tons of material will be removed from the barracks areas. The majority of this material consists of concrete, asphalt, rebar, piping, and fixtures. Increased solid waste generation due to construction and demolition could cause Fort Bragg to exceed its landfill permit. Based on projected building activity, data indicates that landfill capacity could be exceeded in approximately six years. If this happens, Fort Bragg will have to look outside the installation for disposal means, which would likely be very costly. In addition, the state of North Carolina solid waste diversion/reduction goal for FY 00 was 25 percent and the reduction goal for FY 01 has been set at 40 percent. One way to support the State in its goal is to reduce the amount of C&D debris generated and disposed of at Fort Bragg.
- Air quality – Fort Bragg and much of the surrounding region is classified as a nonattainment area for ozone. If Fort Bragg and the surrounding regions do not effectively control and reduce emission of ozone precursors from burning fuels for energy, future development could become more restricted as well as expensive (see the Air Quality section).

Buildings

- Water use – Forecasts on water use predict competition among the region's areas, which would have an adverse effect on area development (see Water Supply section). The increasing rate of water consumption on Fort Bragg will aggravate this problem. Additional emphasis needs to be placed on appropriate uses for drinking water in the future (irrigation of lawns and golf courses, vehicle washing, etc.).

Current Sustainability Activities:

At present, Fort Bragg staff and supporting organizations have begun to consider many of the issues identified above. No comprehensive programs have been established to address all environmental impacts and costs associated with the design, construction, and demolition of facilities. Current activities include the following:

- Development zones – An area covering 5,538 acres known as the "Greenbelt" was established in order to ensure future sustainable development in the cantonment area. Without the Greenbelt, further development would have severely impacted the Red-cockaded Woodpecker (RCW) habitat on Fort Bragg by potentially destroying its ability to move from north to south, creating two isolated populations. The Greenbelt ensures a corridor of movement for the RCW and also serves as a training area for soldiers.
- Green design – Fort Bragg has researched and implemented some sustainable building techniques. For example, current barracks design incorporates green space into each complex wherever possible. This enhances the aesthetic quality of the area and also greatly reduces the amount of runoff (storm water) and debris resulting from rainfall. In January 2000, Fort Bragg, the Savannah District Corps of Engineers, and Knight Architects, Inc. participated in a sustainable design study for the new Combat Aviation Brigade Barracks Complex. Although the majority of the sustainable design and development recommendations were not used due to first cost issues, a few were implemented. Additional use of green atriums and walkways were incorporated and the footprint of the original design was significantly reduced.
- ESPC projects have begun the process of replacing light bulbs in barracks with more energy efficient lights.

The Realm of Possibility:

- "Green design" is no longer something done just by movie stars and born-again hippies living in Oregon. The U.S. Green Building Council's release in 2000 of the Leadership in Energy and Environmental Design (LEED) rating system provides a national standard for evaluating and comparing green building performance. The LEED standards (version 2.0) can be downloaded from www.usgbc.org.

Buildings

- The Army is also serious about green design. The Deputy Assistant Secretary of the Army for Installations and Housing put out a Sustainable Design and Development policy letter on 26 April 00, requiring that the concepts and principles of sustainable design be incorporated into installation planning and infrastructure projects.
- The current renovation of the Pentagon is being done according to green design principles. The first step was to build a separate $10M central receiving facility. Given the security requirements for the building, it was actually designed as an earth-sheltered building with a park on top for Pentagon employees to enjoy. Second, the $1.1B renovation of the Pentagon itself is harnessing market forces to determine how to "green" the historic structure. The contractor has been given a list of performance criteria for the building, some of which have to do with its environmental attributes. Some are mandatory and some are not; however, if the contractor can suggest a way to meet the criteria that will save money over the expected lifetime of the building, and the government accepts the suggestion, then the contractor shares in the anticipated savings by increasing the percentage of profit.
- Fort McPherson held a design charette in FY 00 to do "green" renovation on a historic structure.
- Forts Hood, Carson, and Polk all have green building demonstration projects in the planning stage.
- Fort Knox sells the "salvage rights" to buildings that are on the demolition schedule. The purchaser of the rights can remove windows, doors, flooring, siding, plumbing, and copper wire—but must remove at least 50 percent of the volume of the building. The installation makes about $100K/year on the sale of the salvage rights, but more significantly, it saves hundreds of thousands on reduced demolition costs and disposal costs. Fort McCoy has a similar program.
- Redstone Arsenal has paid a local house mover and developer to move 89 two-story brick duplexes off the installation and into the local community, where they will be sold and reused. The cost was about $9,000 per house versus the $12,000 it would have cost to demolish them.
- The Army has signed a Memorandum of Agreement with Habitat for Humanity to allow them to "deconstruct" buildings on the demolition schedule and sell the salvaged items to support Habitat home-building activities. A pilot project is being developed at Fort Hood with the Austin Texas Habitat affiliate.
- For more information on the realm of possibility and examples of efforts world-wide, see *Building Blocks*, Chapter 5, and *Tunneling Through the Cost Barrier*, Chapter 6, Natural Capitalism.

Fort Bragg 25-year Goals for Buildings:

To be determined by Fort Bragg Command and staff, as advised by members of local and regulatory community, at the Environmental Sustainability Executive Conference on 17-18 April 01.

Buildings

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Air Quality

Challenge: The state of North Carolina is increasingly concerned about ozone and other air pollutants. How can Fort Bragg minimize future costs and operational restrictions while improving regional air quality?

Introduction:

People can live for 30-60 days without food; 3-6 days without water; and 3-6 minutes without air. Clean air is essential to public health, the economy, and the environment. As both industry and population grow in North Carolina, air quality becomes an increasingly important issue for all communities, including Fort Bragg. Concern over air quality translates into additional and more stringent requirements, community concern, and ultimately costs for Fort Bragg.

Fort Bragg is required to monitor emissions from all significant sources and submit an annual emissions inventory to the state of North Carolina under Title V of the Clean Air Act. The emissions inventory must include all Hazardous Air Pollutants (HAPs), Toxic Air Pollutants (TAPs), and "criteria" pollutants for National Ambient Air Quality Standards (NAAQS). The installation

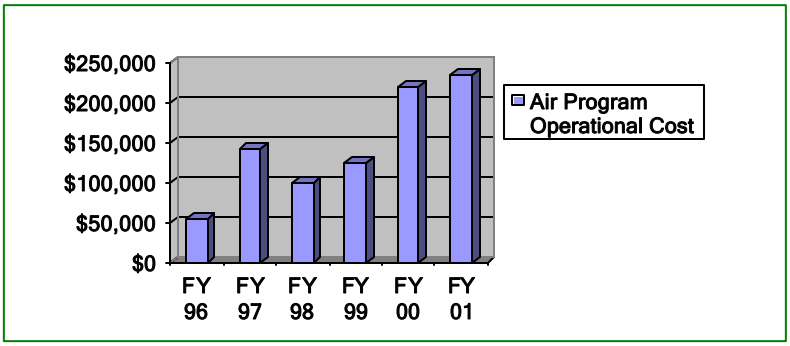
Importance to Fort Bragg

Mission – Though there are currently no restrictions on training due to air quality concerns, regulators can impose restrictions regardless of training or mission impact if the installation does not do its part to improve air quality.

Quality of Life – Poor air quality affects soldiers and families, both in the home and in the workplace. High amounts of ground-level ozone can burn the lungs causing respiratory problems, and even at very low levels, it can aggravate asthma, reduce lung capacity, and increase susceptibility to pneumonia and bronchitis. Clean air is essential to providing world class installations that soldiers and families deserve.

Cost of Operation – Costs to buy out the ODC facility equipment are approximately $3.4M—not including tactical equipment, for which no substitute is available. Fire protection systems on flightlines and in tanks and large air conditioning systems are affected by the skyrocketing price of Class I ozone depleting compounds (ODCs). Fort Bragg may have to purchase or earn "emission offsets" when nonattainment designation occurs. Costs of either approach are expected to be significant.

Figure 12 – Air Program Operational Cost



Environment and the Community – Fort Bragg has 58 significant and 810 insignificant sources of air pollution that have contributed to two outstanding NOVs and two small fines for air permitting violations. Fort Bragg will be in an ozone nonattainment area beginning May 2002 and potentially a particulate matter (dust) nonattainment area in 2005.

Air Quality

received its first Operating Air Permit in 1983 for 17 permitted sources. By FY 00, the permit included 58 significant and 810 insignificant sources.

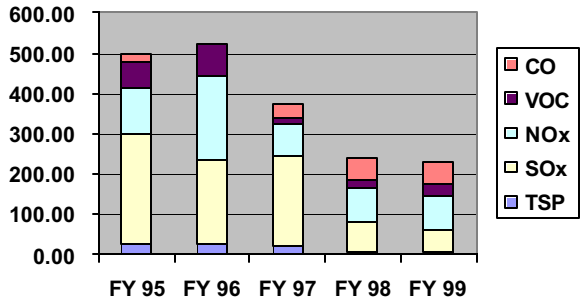
The complexity of the program has increased over the past five years. The costs for maintaining compliance, obtaining permits, operating monitoring equipment, analyzing emissions, and contracting support have been steadily increasing as requirements for the installation have expanded. Figure 12 illustrates costs for Fort Bragg's air operation program for FY 96 through FY 00. Program costs are currently $225,000 per year. New requirements will create need for additional activities that will increase costs.

Activities and Impacts:

Fort Bragg monitors and controls annual emissions of the six NAAQS criteria pollutants. Figure 13 provides a summary of both criteria and hazardous/toxic air emissions from Fort Bragg.

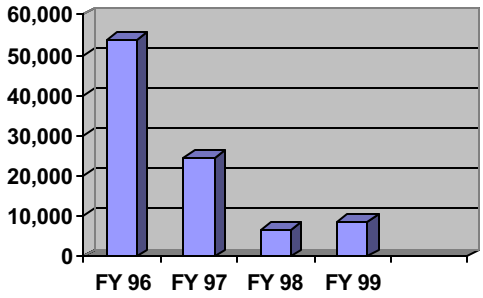
Figure 13 – Emissions by the Numbers

Criteria Pollutants Emission Levels (Tons/yr)



SO_X	Sulfur oxides
NO_X	Nitrogen oxides
VOC	Volatile organic compounds
CO	Carbon monoxide
TSP	Total Suspended Particulates

Hazardous and Toxic Air Pollutants (Pounds/yr)



A list of pollutants emitted is provided in Appendix B.

Lead Emissions (Tons/yr)

FY 95	FY 96	FY 97	FY 98	FY 99
0.08	0.1	1.48	0.04	0.002

Ozone Precursor Emissions (Tons/yr)

Pollutant	Boilers	Generators	Degreasers	Paint Booths	Other	Total FY 99
NO_X	70.0	15.0	-----	-----	0.4	85.4
VOC	3.5	.73	17	7.0	0.07	28.3

Air Quality

The data on ozone precursor emissions includes only pollution resulting from emissions generated by Fort Bragg (most significantly, heating and cooling operations).

Boilers are currently the installation's largest source of particulate matter pollution (5 tons/year). Emissions data for other particulate matter sources, such as fugitive dust generated during training activities and prescribed burning operations, are unavailable. These actions are not covered under the current air permit and the installation is therefore not required to report emissions on training activities or prescribed burning activities.

A dramatic decrease in emissions occurred from FY 96 to FY 97 due to the fact that the installation stopped burning used (waste) oil in boilers at the 82d heat plant. The current permit does not allow burning of used oil on the installation.

Fort Bragg's new Title V Air Permit, which took effect on 28 January 2001 and will be in force for five years, regulates the emissions from the sources identified in Figure 14. Prior Operating Air Permits were purely state-owned and implemented permits. The new permit establishes federal oversight and federal enforcement mechanisms, as well as specific emissions limits for each significant emission source. This requires additional monitoring and reporting, and submitting an annual compliance certification statement. Figure 14 identifies sources monitored under the current permit.

Figure 14 – Permitted Air Sources

Significant Sources	Insignificant Sources
24 large boilers (> 10 million BTU/hr)	377 residential boilers (< 1 million BTU/hr)
15 emergency generators (> 590 kW/hr)	9 commercial boilers (1-10 million MTU/hr)
6 paint booths	155 emergency generators (< 590 KW/hr)
1 paint mixing room	257 parts degreasers
10 gasoline USTs (underground storage tanks)	12 others

The installation currently has two notices of violation and two fines related to air quality. The first, totaling $5,502, was assessed in 1999 for failing to provide notification to the state and failing to conduct emissions testing after the start-up of six new boilers. The second, totaling $3,318, was assessed in 2000 for failing to provide notification of the start-up of three new boilers.

Several types of activities contribute to the air emissions shown in Figure 13. Specifically, heat generation, transportation, military training and prescribed burning of forest (discussed in the Sustainable Training Areas section), and the use of hazardous materials contribute to Fort Bragg's air quality issues. Each type of activity and associated impacts are described below.

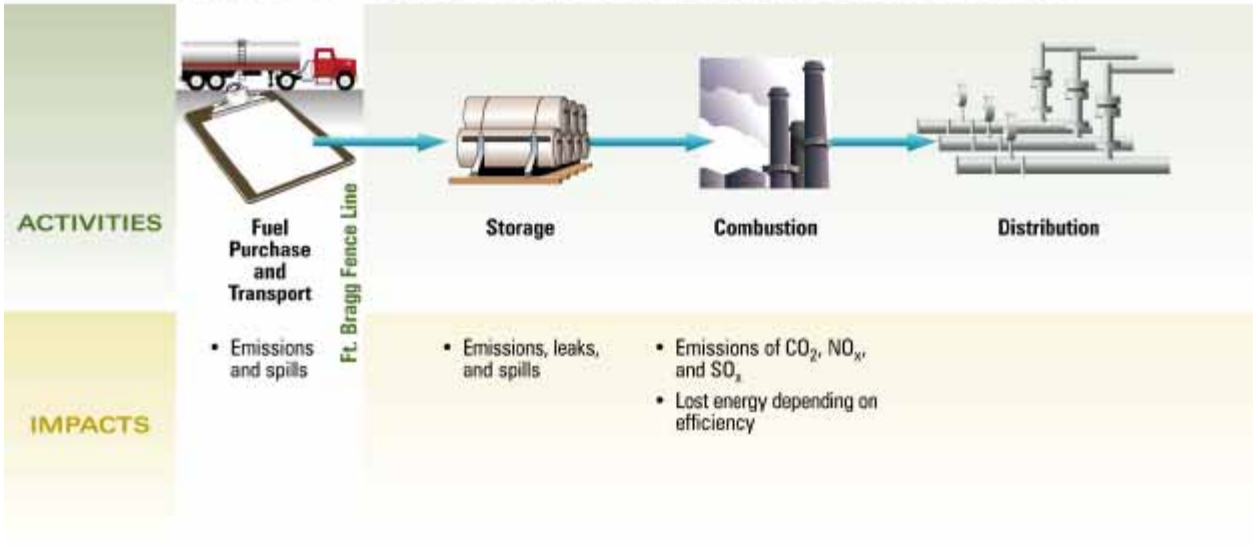
Air Quality

Heat Generation

Fort Bragg relies upon commercial power for 100 percent of the electricity used on-site. The impacts associated with the consumption of commercially provided power by Fort Bragg are discussed in the Energy Use section of this document. Fort Bragg operates 7 heat plants, 7 chillers, and 24 boilers to heat buildings and water on the installation, resulting in the emission of criteria pollutants shown in Figure 13.

Although Fort Bragg does not currently generate any of its own electricity, projects that will produce up to 20 MkW/year on-site for peak shaving and emergency generation purposes are in the planning stages. Proposals for peak shaving (using up to 21 generators) and a synthetic natural gas plant (270,000 gallons of propane storage) may be approved and in operation within the next year. These facilities are not intended to run full-time, but will be used to offset spikes in the cost of natural gas, or in the event of a power interruption to the installation. In addition, the installation may also construct a new media blasting booth and paint booth (servicing 30-40 helicopters per year) in FY 01. All of these proposed actions are still in the planning stages and have not been approved yet. The environmental impacts associated with heat generation are depicted in Figure 15.

Figure 15 – Heat Generation: Activities and Impacts

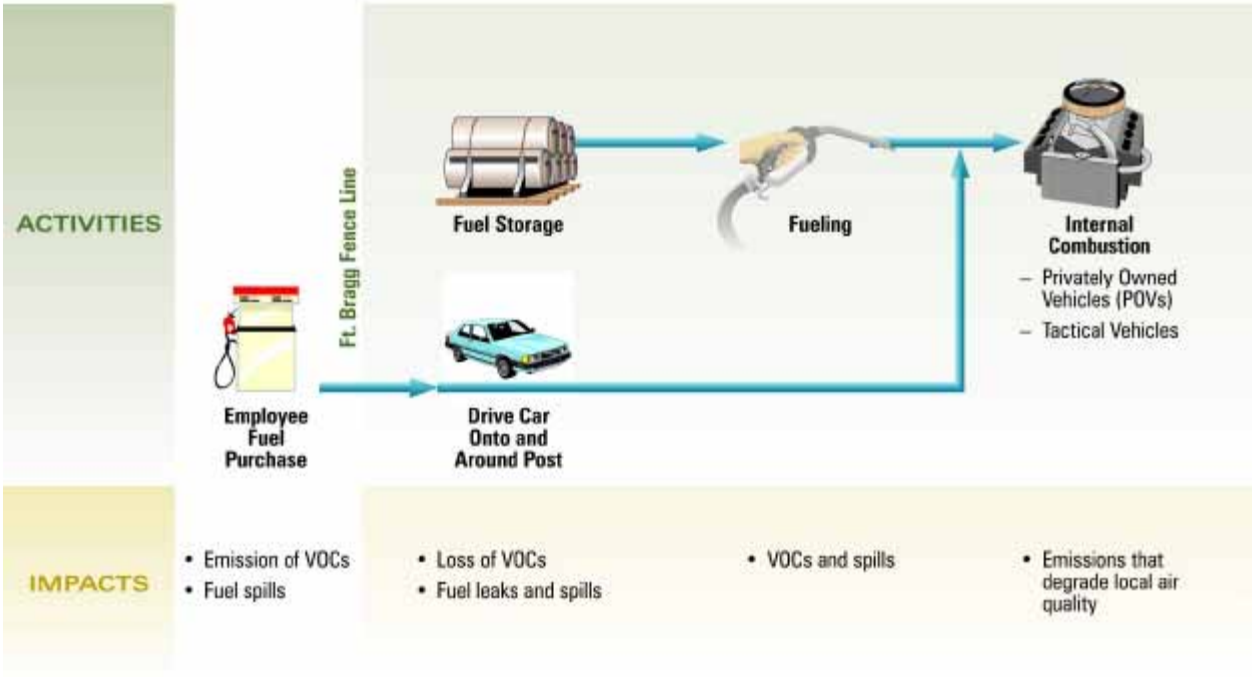


Transportation

Fort Bragg has a daily workforce of 49,785 military and civilian personnel. Assuming an average commute of 20 miles/day for each employee, Fort Bragg workers contribute approximately 131,600 tons of CO_2, 356 tons of NO_X, and 6,400 tons of CO to the local air quality just getting to and from work. These emissions, which are unregulated, exceed the emissions associated with the heat

generation activities conducted on-site at Fort Bragg. These estimates do not include use of government tactical and non-tactical vehicles on Fort Bragg. The environmental impacts associated with transportation are depicted in Figure 16.

Figure 16 – Transportation: Activities and Impacts



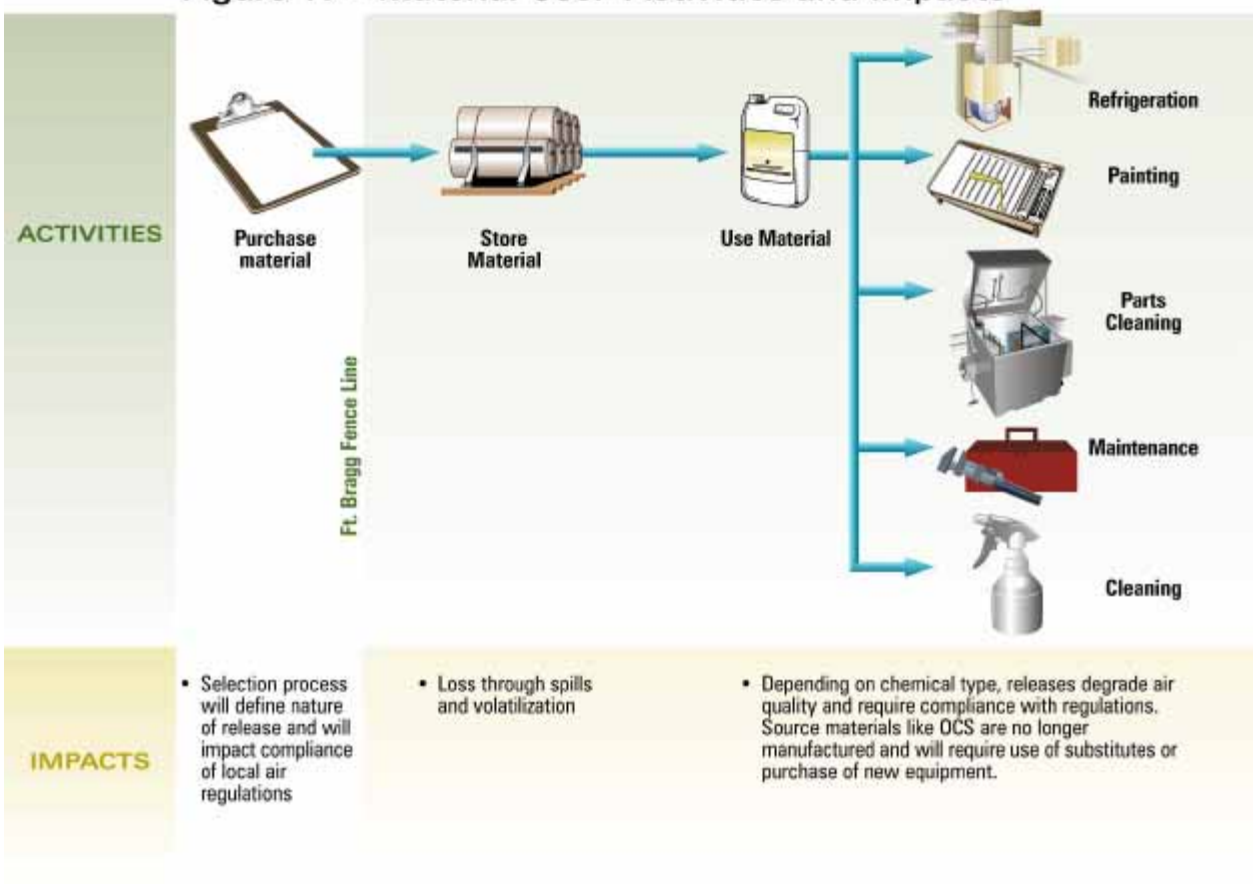
Hazardous Material Use

Volatile hazardous materials contribute to local air pollution. In some cases, hazardous materials released to the air contribute to local air quality issues like smog or surface-level ozone. Others contribute to more regional issues like acid rain, while still others contribute to global environmental issues like depletion of stratospheric ozone.

Some hazardous materials, like fuels, are stored and used in large quantities at Fort Bragg, while others like solvents, paints, and refrigerants are used in smaller quantities at many locations. The diagram on the next page summarizes many of the hazardous air pollutant emission sources at Fort Bragg. The environmental impacts associated with the use of hazardous materials are depicted in Figure 17.

Air Quality

Figure 17 – Material Use: Activities and Impacts



Many hazardous materials are so problematic to the environment that EPA has determined that their production and use is unacceptable and must be restricted or eliminated. At present, one class of chemicals, ozone depleting compounds (ODCs), is targeted for elimination. ODCs were developed in the 1930-40s for use as refrigerants, solvents, fire suppressants, and many other uses. These chemicals interact with and destroy stratospheric ozone, which protects the earth's surface from ultraviolet radiation. Examples of ODCs include chlorofluorocarbon (CFC) and hydrochlorofluorocarbon (HCFC) refrigerants; certain solvents; methyl chloroform, dichloromethane, and carbon tetrachloride found in solvents; and halon for fire suppression on flightlines and around electrical equipment. Because of their impacts, future production of ODCs has been banned worldwide.

Most, if not all, of the fire suppression systems on flightlines and in tanks contain halon, a type of ODC. Because halon is no longer produced or manufactured, the prices of the existing stockpile are skyrocketing. In 1992, the purchase price for ODCs, which included halon, freon, and other types of CFCs, was estimated at $1.00/pound. In 2000, the cost increased to between $50 and $70/pound.

Air Quality

In response to the prohibition on future ODC manufacturing, the Defense Department and the Army have required installations to develop an ODC elimination plan that documents all facility ODC equipment, and prioritizes it for retrofit and/or replacement by FY 03. The Fort Bragg plan estimates the retrofit/replacement cost to be $1.2 to $3.4M. Figure 18 lists the kinds of ODC equipment in use on Fort Bragg that will require replacement.

A DoD strategic reserve of halon has been created to meet the needs in tactical vehicles and equipment. The Assistant Chief of Staff for Installation Management (ACSIM) is currently conducting a study to determine whether the accelerated removal of halon from facilities (before equipment failure) is cost-effective. The removed halon would be stockpiled in the strategic reserve to meet tactical needs.

Figure 18 – Common Users of ODCs

Equipment	ODC
Chiller plants	CFCs and HCFCs
Refrigerators	CFCs and HCFCs
Air conditioners	CFCs and HCFCs
Older appliances	CFCs and HCFCs
Fixed fire suppression systems	Halon
Portable flightline fire protection systems	Halon
Hand-held fire extinguishers	Halon

Fort Bragg uses paints (6 paint booths and 1 mixing room) and solvent degreasing tanks (247 identified units installation-wide). These uses result in the release of 7 tons of volatile organic compounds (VOCs) from the paint booths, and 17 tons of VOCs from the degreasers every year, contributing to ground-level ozone formation (Figure 13). The impacts from uses like aerosol can painting are difficult to characterize because each individual use is very small and difficult to track or control. These kinds of impacts are best controlled through material substitution, or Fort Bragg's Hazardous Material Control Center (HMCC), a "pharmacy" program (see Product and Material Procurement section).

Forecast:

Title V compliance will be closely linked to the New Source Review Program (NSR) which is part of the nonattainment and prevention of significant deterioration programs under Title I of the Clean Air Act. Under this program, all "major" new sources and "major" modifications to existing sources of air pollutants must obtain a NSR permit. Fort Bragg's current proposed modifications

include future projects for peak shaving, synthetic natural gas production, an additional media blasting booth, and related paint booth. This means that Fort Bragg will be required to:

- Reduce emissions or buy "offsets" from other air pollution sources within the area. For every ton of increased emission of nonattainment pollutant, any new source must offset at least 1 ton of that pollutant by reducing existing emissions or by buying offsets from other facilities.
- Certify that all existing sources currently owned are 100 percent in compliance with specified permit limits. This could mean significant increase in costs if additional emission control equipment and technology are required. There is no current cost estimate.
- Comply with the Lowest Achievable Emission Rate (LAER), the most stringent performance standard under the Clean Air Act. This means that each installation or facility will be responsible for investing in control/pollution prevention technology for its emission sources.

Although Fort Bragg's NO_X (nitrogen oxides) and VOC emissions are small when compared to utility companies and industrial sources, offsetting and reduction requirements will be required of Fort Bragg, since the whole area is in nonattainment. If the area around the installation deteriorates sufficiently, Fort Bragg may be able to claim "credits" for significantly controlling and reducing its own emissions. Such credits can become valuable assets in a system that allows facilities to buy and sell emission offsets within a given region in order to allow additional industrial development.

North Carolina is expected to implement former Governor Hunt's Clean Air Plan, "A Strategy for Reducing Ground-Level Ozone by the Year 2007." Fort Bragg is currently compliant with the requirements for criteria pollutants, however, due to increasing levels of ground-level ozone, portions of North Carolina (including Fort Bragg) have been classified as nonattainment areas. This means that the state of North Carolina must take steps to control and reduce ozone and "ozone precursors" which include NOx and VOCs. Fort Bragg's greatest contributors to these pollutants are heat plant boilers, emergency generators, solvent degreasers, and paint booths. Standards and requirements will continue to become more stringent in the future, as will penalties for failing to comply.

Current Sustainability Activities:

- Current projects under the ESPC with Honeywell have already resulted in reduced emissions associated with operating equipment and the types of "fuel" used to generate heat on Fort Bragg. Figure 19 lists pollutant type and amount reduced through ESPC projects to date. Honeywell provided this information.

Figure 19 – ESPC Pollutant Reductions

Pollutant	Reduction (tons)
SO_X	13.14
NO_X	4.75
CO_2	1328.2
Particulates	0.68
Hydrocarbons	0.03
Total	**1,347 tons**

(This equates to the equivalent lifetime removal of 403 automobiles.)

Air Quality

- All No. 6 heating oil has been replaced by No. 2 heating oil and natural gas which provide cleaner and more efficient combustion, resulting in fewer emissions.
- Used oil is no longer burned on Fort Bragg.
- ESPC projects have also begun to address Class I ODC requirements by replacing and retrofitting large chiller plants to achieve energy use reductions.
- The hazardous materials management center has reduced or eliminated the use of various chemicals and products that impact air quality (see Product and Material Procurement section).

The Realm of Possibility:

- 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. Or large land-owning organizations such as Fort Bragg could start their own program to offset the vehicle emissions caused by transportation activities. For more information, visit http://www.treesftf.org/travel.htm.
- TACOM and the Army Research Lab are testing and evaluating new technologies for solvent-free degreasing.
- Currently available technology can reduce building energy use by 80-90 percent over 1970's technology. This results in decreased air emissions (see Buildings and Energy Use sections).
- 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.
- GSA provides vehicles that run on alternative fuels, such as natural gas, propane, and electric hybrids. These vehicles have reduced air emissions. Honda, Nissan, and Ford also have alternative-fueled vehicles on the market. Fueling capabilities are needed to make this a viable option.
- Fuel cells turn hydrogen and air into electricity and nothing else—no harmful emissions. DoD currently has a program for evaluating the use of fuel cells on military installations. Of course, production of the hydrogen requires the burning of conventional or alternative fuel somewhere, but at the point of use, no air pollution is emitted.
- Rocky Mountain Institute developed a concept design for a "hypercar" and put it in the public domain in the early 1990s. By reconfiguring three key design elements, they estimate that 70-80 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 ultra-light by using composites instead of metal, with a weight 2-3 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 and generate no harmful air emissions. 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 have hybrid-electrics on the market in Europe, Japan, and the U.S. already.

- Intense speculation is surrounding the 2002 promised release of entrepreneur and inventor Dean Kamen's latest invention, referred to as "IT". Journalist-author Steve Kemper says the invention will "sweep over the world and change lives, cities, and ways of thinking." Kamen says that IT will provide an alternative to devices that "are dirty, expensive, sometimes dangerous, and often frustrating, especially for people in the cities." No one except a few venture capitalists know what IT really is, though many speculate that it is a pollution-free personal transportation device—which could reduce the air pollution and fuel use associated with the current transportation system.
- 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 provide the majority of its electrical needs. Fort Hood and Fort Irwin have installed "solargizers", active day lighting 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.
- The Army Research Lab is developing a water-based CARC paint and primer that will cut down on air emissions from vehicle painting in paint booths.
- For more information on the realm of possibility and examples of efforts world-wide, see *Climate: Making Sense and Making Money,* Chapter 12, Natural Capitalism.

Fort Bragg 25-year Goals for Air Quality:

To be determined by Fort Bragg Command and staff, as advised by members of local and regulatory community, at the Environmental Sustainability Executive Conference on 17-18 April 01.

Water Supply

Challenge: Potential sources of water for Fort Bragg consumption have been steadily declining (both in quantity and quality) due to overuse. How can Fort Bragg reduce its dependence on these sources and provide premium quality drinking water as well as the "right" quality water for other uses, without aggravating future regional water supply issues?

Introduction:

Fort Bragg currently draws an average of 8.5 million gallons of water from the Little River each day. Fort Bragg also has the option to purchase up to 3 million gallons/day from Fayetteville to meet emergency needs.

Fort Bragg operates five public water systems that are permitted for operation by the state of North Carolina. The primary water system is the water treatment plant located on Manchester Road. The water treatment plant was built in 1918 and upgraded to a 10 million gallon/day capacity. In 2000, the capacity was upgraded again to 16 million gallons/day. The water treatment plant treats and supplies drinking water to the entire cantonment area,

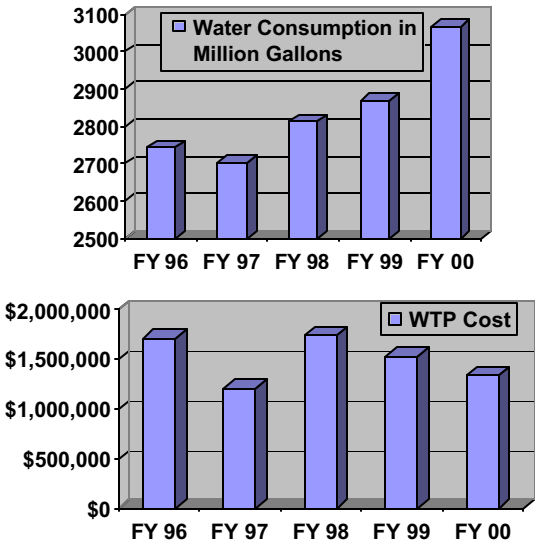
Importance to Fort Bragg

Mission – A reliable source of drinking water is critical to Fort Bragg's continued operation. Shortfalls could result during times of drought or from depletion of the source. The trend toward increasing use would worsen shortfalls.

Quality of Life – A reliable source of clean water is vital to the support of personnel.

Cost of Operation – Current costs of water distribution, treatment, and purchase are close to $1.5 million per year. Projected costs to secure water or new sources could be as high. Water conserving technologies in new construction and renovation could reduce dependence and cost by $670,970/year. Based on the outcome of the privatization decision, the installation may face heavy future investments in the water treatment plant.

Figure 20 – Water Consumption and Cost FY 96 - FY 00



Environment and the Community – North Carolina recognizes the Upper Cape Fear Basin, which feeds the Little River, as a rapidly depleting source due to overuse. Water conservation measures will need to be employed to sustain these sources.

Water Supply

Simmons Army Airfield, the Central Vehicle Wash Facility, Army and Air Force Exchange Stores (AAFES) Car Wash, and all of Pope Air Force Base (including the golf course).

The drinking water distribution system is composed of over 2,000,000 linear feet of pipeline. Irrigation for Fort Bragg's two golf courses is supplied by underground wells. Underground wells also supply water to all training areas on Fort Bragg with the exception of Camp Mackall's water supply, which is purchased from Southern Pines.

Since 1993, the water treatment plant has received several citations for violating the Safe Drinking Water Act (SDWA). These include: 14 violations for exceeding total trihalomethane (TTHM) requirements and for failing to notify the public; 1 violation for failing to monitor TTHM requirements; 7 violations for failure to meet public education requirements for exceeding lead requirements; and 1 violation for failing to report TTHM levels within 48 hours. These citations resulted in a fine of $1,250,000. Payment will be in the form of $925,000 in supplemental environmental projects, and the remaining $325,000 will be paid in cash. Drinking water from the plant currently meets all drinking water standards.

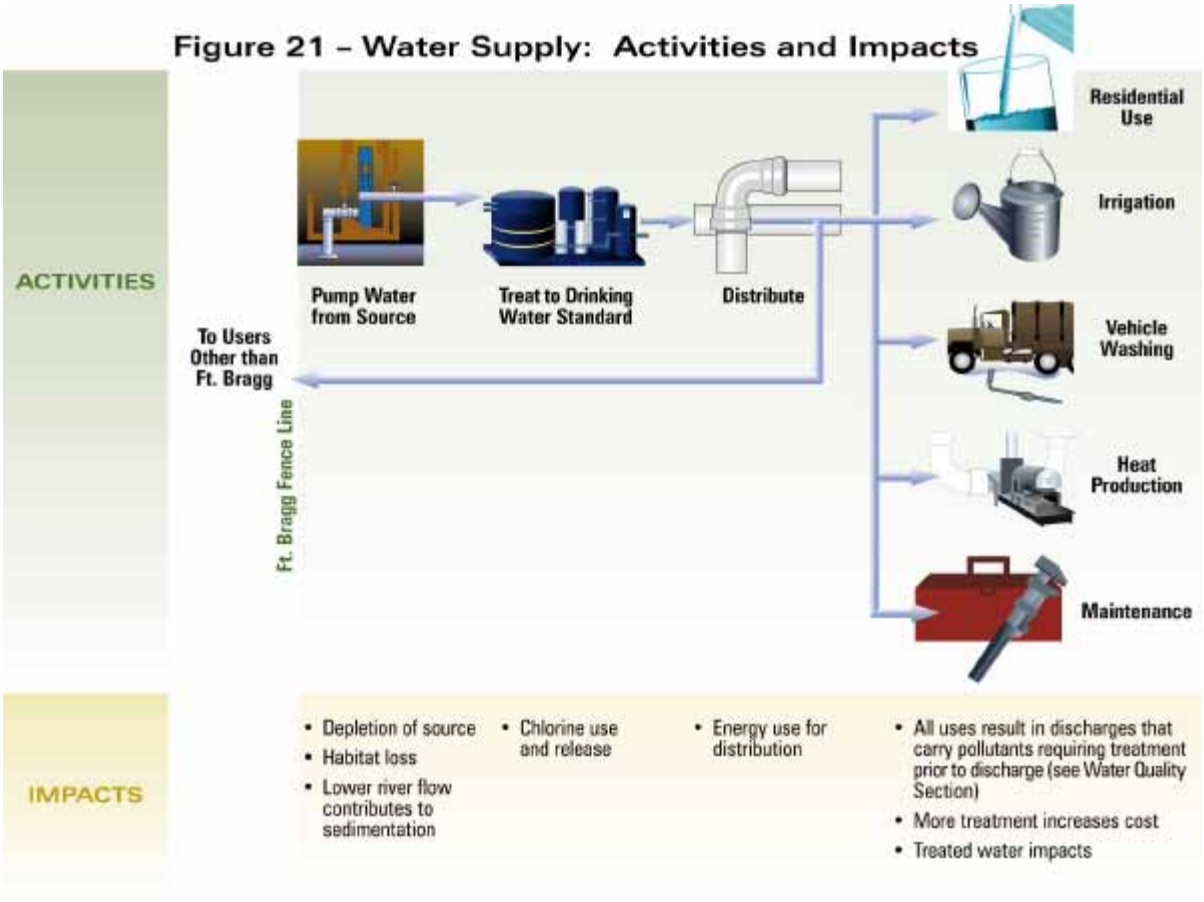
In 1999, a Water System Performance Evaluation was conducted on the water treatment plant by the U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM). In addition to finding numerous deficiencies in plant operation and maintenance, the evaluation also concluded that Fort Bragg does not have a comprehensive water resource management plan. In response to this deficiency, Fort Bragg developed a water resources management plan that evaluates emergency contingency options.

Activities and Impacts:

Fort Bragg uses water in most activities. Critical uses are summarized in Figure 21, as well as the environmental impacts resulting from specific activities to obtain, purify, distribute, and consume water. Many of these impacts are also described in the Water Quality section.

Water Supply

Figure 21 – Water Supply: Activities and Impacts



Forecast:

Fort Bragg has increased its water consumption from 2,202 million gallons in 1992 to 3,067 million gallons in 2000, which is a 72 percent increase. This increase has occurred without a rise in population. In drought or emergency conditions, the Little River is incapable of supporting daily water demands for the installation, and additional water (up to three million gallons per day) must be purchased from Fayetteville.

In addition, since 1970 the population of the Raleigh-Durham-Chapel Hill area has doubled. The growth of water-using industries has grown with this population increase. The State is currently pursuing a proposed inter-basin water transfer project that diverts water from the Upper Cape Fear Basin for use by the Raleigh-Durham-Chapel Hill community. The project removes water from the Cape Fear River Basin to augment the Neuse River Basin in support of the enormous urban growth in Raleigh and Cary. The Little River is part of the Cape Fear River Basin, and may be adversely

Water Supply

affected by this proposal along with the rest of the region. The implications of increased demands on the Upper Cape Fear watershed and the Little River are difficult to determine at this time. Data that could assist Fort Bragg in better determining the status of their current and future water source are listed in Figure 22.

Upon contamination or depletion of the Little River, the next available ground water is the Upper Middendorf Aquifer, followed by the Black Creek Aquifer. If that water is contaminated, the next remaining water source is the Upper Cape Fear Aquifer, which is already impaired in South Carolina. Therefore, if the Little River becomes contaminated or depleted, Fort Bragg as well as other communities, may have future difficulty producing or purchasing sufficient potable water.

Figure 22 – What We Don't Know Can Hurt Us

It is difficult to define the implications of increased demand on the Upper Cape Fear watershed and the Little River without more specific data. Data needs that could assist Fort Bragg in better quantifying the nature of their current water source include:

- Flow data upstream and downstream of the intake on the Little River. There are currently no US Geological Survey gauge stations on the Little River or streams draining from Fort Bragg.
- Water quality monitoring data on stream segments that impact the Fort Bragg intake.
- Storm water quality outfall monitoring data.
- Watershed delineation, land use assessment, and imperviousness determinations for Fort Bragg.
- Information on stream morphology.

The Upper Middendorf Aquifer is currently considered by Fort Bragg to be polluted beyond drinking water limits. Pollution occurred as a result of numerous hazardous material spills (fuel, petroleum products, etc.) throughout the history of the installation and contamination from pre-1950's landfills. Fort Bragg currently has 39 documented restoration sites managed by the Installation Restoration Program. Of the 39 sites, 34 are Solid Waste Management Units (SWMUs). Seven of these sites have confirmed ground water contamination by the following contaminants: fuel, petroleum products, volatile and semi-volatile organics, pesticides, polychlorinated biphenyls (PCBs), metals, benzene, and trichloroethylene (TCE). Fort Bragg spent $885,026 on installation restoration in FY 00 and will spend an estimated $1,335,000 in FY 01.

Loss of capacity from the Little River would necessitate the development of ground water sources for use as drinking sources and/or the implementation of conservation technologies and practices to reduce usage of surface water. It would also result in additional costs to purchase water from the community as well as require rationing in times of shortage. If the water systems at Fort Bragg are privatized, the installation may also experience an increase in the price of water as rates are commercialized.

Water Supply

If privatization does not occur, Fort Bragg faces significant future investments in the water treatment plant. One option is to attempt to fix existing equipment, at an estimated cost of $2M. If this project fails, however, the installation will be forced to invest heavily in total plant replacement at an estimated cost of $24M.

A current plan exists to pipe up to 1 million gallons/day of backwash created during drinking water treatment to the sewage treatment plant. The sewage treatment plant is currently at 68 percent of its capacity based on calculations by the NC Department of Environmental and Natural Resources (NCDENR). At 80 percent capacity, the installation may be required to conduct an engineering study and submit the study to the state. NCDENR may assess future actions or penalties against the installation once the plant exceeds the 80 percent mark, but does not have the authority to do so at this time. With increasing consumption and ongoing real property development, the demand for drinking water is expected to rise continually over the next several years. New barracks design includes individual bathrooms as opposed to the old "gang shower" style, which is expected to increase water consumption, and irrigation systems for landscaping that draw water from the water treatment plant. This, in turn, will increase the load on the waste water treatment plant. Future consideration for alternative uses of backwash may be necessary as an alternative to piping backwash to the waste water treatment plant.

Current Sustainability Activities:

At this time, Fort Bragg does not have a formal water conservation program to monitor real time demand, optimize distribution systems, educate the public, and control peak consumption. In addition, Fort Bragg does not know if Pope AFB, a user of Fort Bragg's drinking water, has instituted a water conservation program. Water conservation leverages cost reduction achieved through energy conservation efforts by reducing the energy load required to collect and distribute water throughout the installation. Significant savings can be produced through water conservation efforts without compromising quality of life for water consumers. Water conservation efforts will also decrease the load for both the water treatment and waste water treatment plants.

Fort Bragg has explored some potential water conserving projects. For example, a blind test project for water conservation was conducted at Callahan Gym in 1998. The test was conducted to assess whether or not any difference could be discerned between old, low efficiency fixtures and new, high efficiency fixtures. High pressure, low flow toilets, shower heads, and faucets were installed in the men's and women's locker rooms. To date, no one has noticed a difference.

There is a proposal for water conservation projects under the existing ESPC with Honeywell. Water conservation efforts can result in energy savings associated with the power consumed by the water pumps and distribution system. The proposal has yet to be approved.

Water Supply

The Realm of Possibility:

- The REEP model shows that implementing water conservation opportunities at Fort Bragg would save 594,482 gallons of water/year and 4,342 MBTUs of energy.
- The U.S. Green Building Council's release in 2000 of the Leadership in Energy and Environmental Design (LEED) rating system provides a national standard for evaluating and comparing green building performance. Water conservation is part of the LEED standards, which can be downloaded from www.usgbc.org.
- Xeriscaping is a landscape design method that creates elegant and water-efficient landscapes that require little or no irrigation, by using native plants that are as attractive as the traditional ones. "Water-efficient landscaping also saves such costs as labor, fertilizer, herbicides, and fuel, plus agrichemical runoff, noise and fumes of moving, and generation of yard wastes." (p. 219, Natural Capitalism).
- Irrigation meters are in use in west Texas to save one to two-thirds the amount of water formerly used for irrigation. A $1 block of gypsum is buried at the root zone. Two wires embedded in the gypsum run back to the surface to a clip-on meter that reads soil moisture. Drop irrigation, which delivers a small amount of water directly to the root zone of plants as it is needed, also cuts down drastically on water use.
- The Army's Central Vehicle Wash Facilities, including the one at Fort Bragg, treat and recycle the wash water in a closed-loop system that saves millions of gallons of water every year.
- Composting toilets eliminate the need to use water to carry human wastes, which accounts for 26 percent of residential water use. They also eliminate the sewage collection and treatment requirements. They produce a humus-like product that can be used for soil amendments. The life-cycle cost is less than that of water delivery, plus sewage collection and treatment. Fort Carson, CO, has installed several composting toilets at the parks and playgrounds on post. The National Park Services uses these types of toilets extensively in the National Parks.
- Clothes washing accounts for 23 percent of residential water use, and a similar amount of residential sewage production. Horizontal-axis washers use 40-75 percent less water, clean clothes better because the soap solution is concentrated, and make clothes last longer because they are not agitated. They are used extensively in Europe, and U.S. manufacturers introduced them in 1996-98. Though the initial cost is about twice that of a conventional washer, they pay back in 3-4 years because of the reduction in use of energy, hot water, and soap. Forts Lewis and Carson have installed horizontal-axis washers in barracks and guest quarters.
- Use of "graywater" from showers, sinks, tubs, and washing machines for non-potable uses such as irrigation and toilet flushing is technically feasible. Such a system at the Roseland III office park in New Jersey cut water usage by 60 percent. The California Plumbing Code allows for the use of graywater for such purposes.
- For more information on the realm of possibility and examples of efforts world-wide, see *Building Blocks*, Chapter 5, and *Aqueous Solutions,* Chapter 11, Natural Capitalism.

Water Supply

Fort Bragg 25-year Goals for Water Supply:

To be determined by Fort Bragg Command and staff, as advised by members of local and regulatory community, at the Environmental Sustainability Executive Conference on 17-18 April 01.

Water Supply

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APPENDIX A

Renewables and Energy Efficiency Planning System
Projections of Potential Energy Savings

APPENDIX B

HAP/TAP Actual Annual Emissions (lb/yr)

Chemical	FY 96	FY 97	FY 98	FY 99
Acetaldehyde	1.01	.54	2.0	2.1
Acrolein	16	.08	.27	.28
Ammonia	157.45	0.0	-----	-----
Antimony Compounds	12.42	6.15	.79	.33
Arsenic & Inorganic Arsenic Compounds	58.28	44.48	2.2	1.1
Barium Compounds	-----	-----	4.8	4.9
Benzene	250.86	5.08	8.3	8.9
1,3 Butadiene	.042	.02	.098	.10
Beryllium & Compounds	1.23	.41	.64	.66
Cadmium & Compounds	60.47	6.7	2.1	2.2
Cresylic Acid	63.8	0.0	-----	-----
Di(2-ethylhexyl)pthalate (DEHP)	8.83	5.3	2.9	-----
Tetrachlorodibenzo-p-dioxin 2378	.0000075	.0000028	.000001	.0000014
Dibenzofurans	.01	.0036	.0013	.0018
Chlorine	14.42	5.33	1.9	2.7
Chlorobenzene	2.25	0.0	-----	-----
Chromium Compounds	42.46	19.66	7.3	132.0
Cobalt Compounds	27.99	6.84	.92	36.0
Cumene	24.79	0.0	-----	-----
Dichlorodifluoromethane	1260.0	0.0	-----	-----
Dichlorobenzene	-----	.01	1.4	1.6
Ethyl Benzene	4737.74	459.87	7.3	25.0
Ethyl Acetate	100.99	5.72	6.1	4.6
Ethylene Oxide	140.0	700.0	84.0	45.0
Formaldehyde	285.34	173.28	85.0	88.0
Glycol Ethers	-----	-----	4.0	-----
Hexane	300.16	16.36	1962.0	2019.0
Hexamethylene 1,6-diisocyanate	63.98	4.44	11.0	9.5
Hydrogen Chloride	4789.79	10883.45	812.0	858.0
Hydrogen Fluoride	20.46	7.56	2.7	3.8
Lead Compounds	200.88	2967.97	73.0	3.8
Manganese & Compounds	35.16	31.67	2.6	1.7
Mercury & Compounds	22.5	6.35	3.1	4.0
Methanol	-----	27.57	26.0	34.0
Methyl Chloroform	59.8	2.15	1.8	2.4
Methylene Chloride	229.8	34.93	53.0	102.0
Methyl Ethyl Ketone	5521.06	1606.16	2141.0	2390.0
Methyl Isobutyl Ketone	2762.43	209.93	303.0	399.0
Napthalene	61.15	5.9	2.7	5.0
Nickel & Compounds	552.26	119.87	12.0	3.4
Perchloroethylene (Tetrachloro-ethylene)	59.8	1.5	2.9	6.1
Perchlorinated Biphenyls (aroclors)	.0064	.0024	.0008	.0012
Polycyclic Organic Matter (POM)	3.81	4.78	1.5	1.7

Selenium Compounds	8.73	.73	.10	.027
Strontium Chromate	-----	-----	34.0	-----
Styrene	12.77	0.0	-----	-----
Toluene	7731.18	734.25	918.0	926.0
Vinyl Acetate	.61	.68	1.1	.77
Xylene	23516.9	6537.14	23.0	1513.0
0-Xylene	481.45	.11	-----	-----
Zinc Chromate	1.14	1.59	.54	.32
Total	**53,686 7**	**24,645**	**6,610**	**8,639**

(-----) denotes chemicals that were not required for a particular year.

APPENDIX C

Improvements and Projects for WWTP

Project	FY	Cost
Install UV disenfection system	96	$1,170,000*
Replace aerator drive	97	$41,500
Repair/replace sewer lines	97	$709,100
Repair/replace sewer lines	98	$157,800
Repair variable drive	98	$16,300
Replace pump	98	$12,000
Chemical feed system	98	$13,600
Upgrade lift/ejector stations	98	$363,100
Replace exhaust system	98	$67,800
Install toeplates	98	$22,100
Repair/replace sewer lines	99	$659,200
Chemical feed system	99	$112,300
Upgrade sludge equipment	99	$571,600
Repair/replace sewer lines	00	$471,500
Repair aerator	00	$68,500
Repair lift/ejector stations	00	$107,300
Replace oxygen element	00	$10,300
Pump WTP backwash to WWTP	00	$30,000

*Although the installation installed a $1,170,000 ultra violet (UV) disinfection system in 1996, the system is not used. Due to installation error, the system did not function properly and was abandoned. The plant currently uses chlorine gas for disinfection.

APPENDIX D

Fort Bragg Hazardous Chemical Inventory FY 96 - FY 99

Chemical	FY 96 (lbs)	FY 97 (lbs)	FY 98 (lbs)	FY 99 (lbs)
Acetylene	12,023	NR	NR	NR
Aluminum Sulfate	30,000	16,000	16,000	98,540
Algaecide H-5000	35,976	NR	NR	NR
Ammonia	5171	3666	3666	3660
Antifreeze	161,778	96,450	120,990	107,550
Brake fluid	11,949	16,370	24,860	26,000
Brake fluid silicone	15,087	NR	NR	NR
Caustic soda	2560	NR	NR	NR
Chlorine (liquid)	29,350	28,300	28,300	28,300
Cleaning compound	28,717	NR	NR	NR
Cleaning lubricant	NR	NR	8350	NR
Compressed gas (O2)	28,558	8860	15,900	16,796
Decontamination Soln # 2	209,920	48,980	48,980	48,980
Dry cleaning solvent	9506	NR	NR	NR
Fertilizer (various)	28,019	12,700	NR	NR
Fog oil	399,221	115,950	115,950	115,950
Freon 11	28,072	NR	NR	NR
Freon 12	15,768	NR	NR	NR
Freon 123	10,000	NR	NR	NR
Fuel, diesel	**06**	2,848,470	2,825,910	1,050,000
Fuel, kerosene	64,684	11,960	8260	NR
Fuel, LPG	**05**	296,640	295,380	282,250
Fuel, #2 oil	**06**	7,635,730	6,985,180	11,471,840
Fuel, #5 jet	**06**	NR	NR	NR
Fuel, #6 oil	NR	2,597,710	NR	1,212,000
Fuel, #8 jet	**06**	3,589,310	2,036,150	2,096,430
Fuel, reg unleaded	**06**	1,593,770	1,111,630	1,314,760
Gear oil	NR	28,540	57,970	46,060
Grease (assorted)	46,622	37,760	57,970	46,060
Hydraulic fluid	56,076	84,380	107,230	88,730
Hydrofloursilic acid	64,500	41,650	41,650	58,310
Hydroquinone	**02**	NR	NR	NR
Lime (assorted)	45,430	39,260	39,260	85,500
Lube oil (assorted)	391,660	335,590	337,370	281,110
Magnesium hydroxide	59,047	49,980	49,980	29,160
MEC 317	10,090	NR	NR	NR
MEC 410	20,640	NR	NR	NR
Methanol	6804	NR	NR	NR
Mineral spirits	14,014	NR	NR	NR
Ozzy Juice	34,621	26,300	23,690	27,040
Paint, CARC	55,425	8240	5960	NR

Paint, enamel	25,764	NR	NR	NR
Paint, latex	5035	11,460	7960	9890
Safety Kleen solvent	1512	**04**	20,970	25,690
Sodium carbonate	NR	13,200	13,200	13,200
Sodium hydroxide	97,800	NR	NR	NR
Sulfuric acid	74,043	28,502	1400	700
Super tropical bleach (STB)	**04**	25,000	25,000	25,000

NR – Quantities did not meet reporting requirements.
Bold numbers denote range codes:
02 – from 100 – 999
03 – from 1,000 – 9,999
04 – from 10,000 – 99,000
05 – from 100,000 – 999,999
06 – from 1,000,000 – 9,999,999

APPENDIX E

List of Abbreviations

AAFES	Army and Air Force Exchange Stores
ACSIM	Assistant Chief of Staff for Installation Management
ARDEC	Armament Research, Development and Engineering Center
AUL	Authorized User List
BMP	Best Management Practice
BOD5	Biological Oxygen Demand
C&D	Construction and Demolition
CAA	Clean Air Act
CERL	Construction Engineering Research Laboratory
CFC	Chlorofluorocarbon
CHPPM	Center for Health Promotion and Preventive Medicine
CP&L	Carolina Power and Light Company
DLA	Defense Logistics Agency
DoD	Department of Defense
DRMO	Defense Reutilization and Marketing Office
EO	Executive Order
EPCRA	Emergency Planning and Community Right to Know Act
EPP	Environmentally Preferable Product
ESPC	Energy Savings Performance Contract
GSA	General Service Administration
HAPS	Hazardous Air Pollutants
HCFC	Hydrochlorofluorocarbon
HMCC	Hazardous Material Control Center
HW	Hazardous Waste
IMPAC	International Merchant Purchase Authorization Card
IRP	Installation Restoration Program
ITAM	Integrated Training Area Management
ITAM	Training Area Management
LAER	Lowest Achievable Emission Rate
LCID	Land clearing and inert debris
LEED	Leadership in Energy and Environmental Design
LUAC	Land Use Advisory Commission
MBTU	Million British Thermal Units
MKW	Million Kilowatts
MMB	Mates and Material Maintenance Branch
MSW	Municipal Solid Waste
NAAQS	National Ambient Air Quality Standards
NCDENR	North Carolina Department of Environmental and Natural Resources
NCNG	North Carolina Natural Gas Company
NOV	Notice of Violation
NOx	Nitrogen Oxides
NPDES	National Pollutant Discharge Elimination System

NSR	New Source Review Program
ODC	Ozone Depleting Compound
OEECM	Operational and Environmental Executive Steering Committee for Munitions
OWS	Oil/Water Separators
PCB	Polychlorinated Biphenyl
POL	Petroleum-based Products
PWBC	Public Works Business Center
RBC	Readiness Business Center
RCI	Residential Communities Initiative
RCW	Red-cockaded Woodpecker
REEP	Renewables and Energy Efficiency Planning
SAAF	Simmons Army Airfield
SAS	Satellite Accumulation Sites
SDWA	Safe Drinking Water Act
SERDP	Strategic Environmental Research and Development Program
SOP	Standard Operating Procedure
SSSC	Self Service Supply Center
SWMU	Solid Waste Management Units
TACOM	Tank-automotive and Armaments Command
TAPS	Toxic Air Pollutants
TCE	Trichloroethylene
TSD	Treatment, Storage, and Disposal
TTHM	Trihalomethane
USASOC	United Sates Army Special Operations Command
UV	Ultraviolet
UXO	Unexploded Ordnance
VOC	Volatile Organic Compound
WTP	Water Treatment Plant