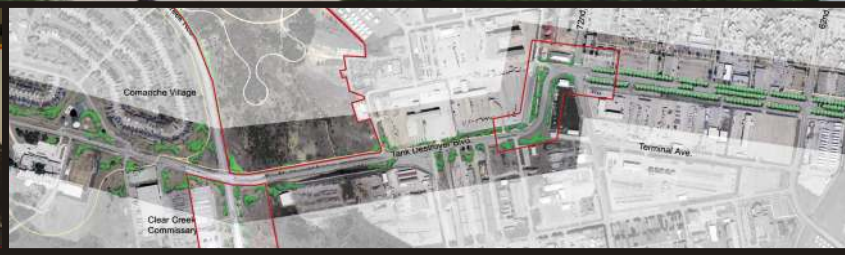
FORT ★ HOOD
INSTALLATION DESIGN GUIDE

March 2007



Sustain the Mission ★ Sustain the Environment ★ Sustain the Community

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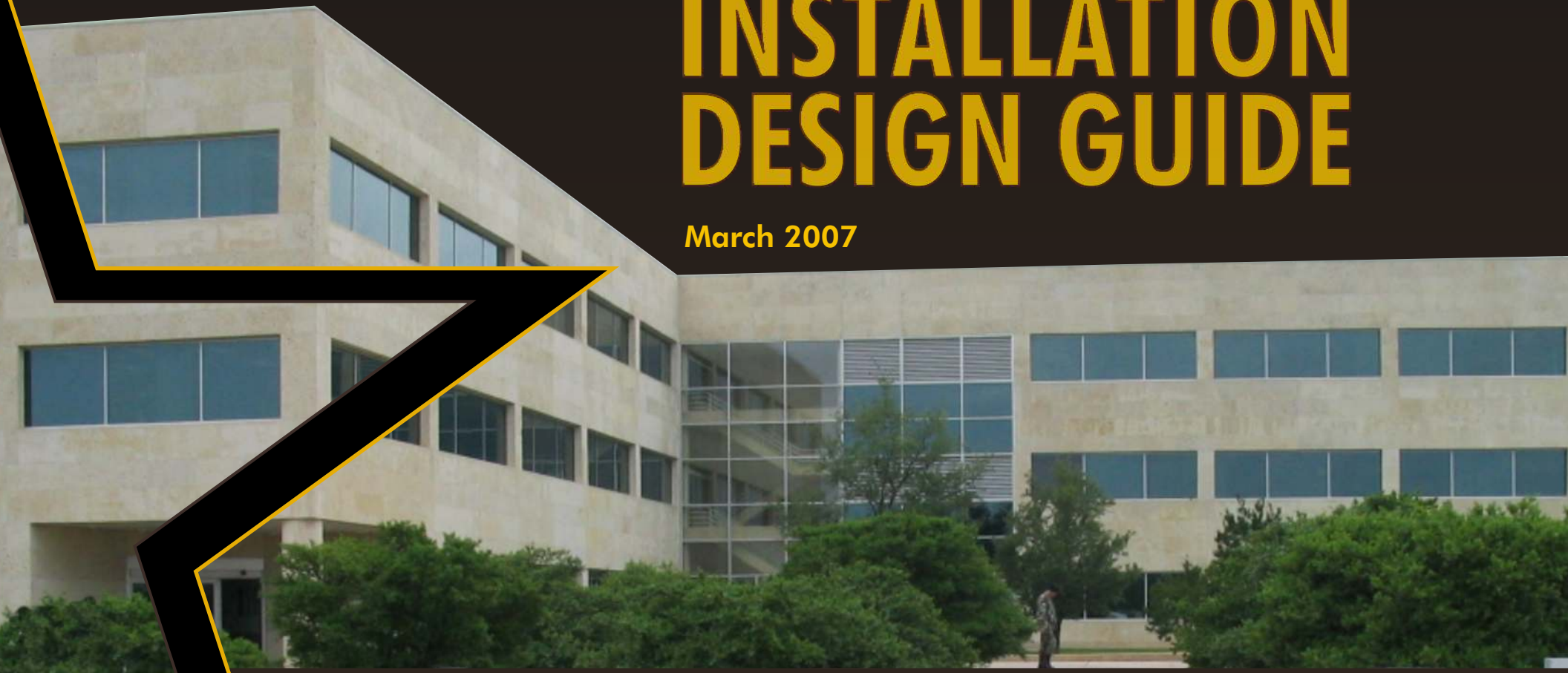

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SECTION 1

Introduction

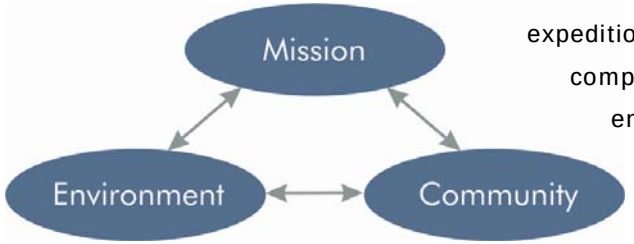
The military installation at Fort Hood, Texas (also referred to herein as "the Installation"), comprising 217,337 acres, is the only installation in the United States capable of stationing and training two Armored Divisions. Located in the central portion of Texas between Killeen and Copperas Cove, the Installation is approximately 60 miles north of the state's capital city of Austin and 50 miles southwest of Waco.

"Meet current and future mission requirements by sustaining land, air and water resources"

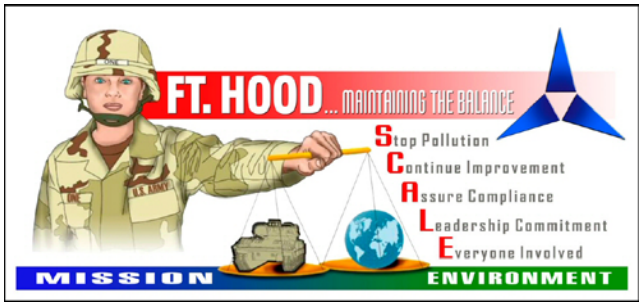
Fort Hood IDG Goal

The Mission of Fort Hood

The mission of Fort Hood is as "a power projection platform, in support of the full spectrum of operations; provides responsible stewardship of resources; provides services and maintains infrastructure; enables training of joint/combined expeditionary forces; mobilizes/demobilizes reserve component forces; establishes a safe, secure environment; provides for the well-being of the Department of the Army family; fosters relationships with surrounding communities; and sustains/supports Army transformation."



Supporting the mission, sustaining the environment, and improving community life.



"Strengthen Fort Hood operational capacity by reducing our environmental footprint through more sustainable development and design practices"

Fort Hood IDG Goal

This installation design guide has been prepared in support of the mission of Fort Hood. All design guide requirements and recommendations within this documentation are consistent with, and support, the mission of Fort Hood.

1.1 PURPOSE

The purpose of the *Fort Hood Installation Design Guide* (IDG) is to provide guidance for standardizing and implementing sustainable planning, programming, design, and construction throughout the Installation in support of mission readiness. The sustainable design and development standards include not only the visual impact of features on the Installation but also the impact of projects on both the built and the natural environments. The IDG sets local conditions and appearance standards to be met. As such it defines installation requirements and complements Army Standard Designs and MILCON Transformation (MT) construction efficiencies to ensure savings in construction costs and expedited delivery do not compromise expectations of Army facilities.

The IDG includes standards and general guidelines for the design issues of:

- Site planning;
- Architectural character, colors, and materials;
- Whole building design, including creating high-performance, healthy, energy-efficient, and safe buildings;
- Vehicular and pedestrian circulation; and
- Outdoor elements, including plant material, seating, signage, lighting, and utilities.

Careful placement of trees provides multiple benefits at Fort Hood, such as shading buildings to reduce energy costs.

The design guidelines incorporate sustainable design and development into all standards, criteria, and recommendations. The guidelines also address quality of design, maintenance, historical and cultural considerations, force protection, safety, compatibility, construction management, and training and education.

1.2 GOAL

The Army goal for all IDGs is to provide a clear, comprehensive approach to establishing and maintaining a positive visual image throughout the Installation and to implementing appropriate

design standards. This is accomplished by providing a systematic process for development that is defined through description, analysis, synthesis, and implementation.

1.3 OBJECTIVES

The Army objectives for the IDG are:

- To provide a set of general design standards and guidelines that define color, materials, style, signage, and other aspects of design for all visual elements surveyed;
- To provide standards and guidelines for the selection of materials for new construction, renovation, maintenance, and repair projects;
- To provide guidance for employing sustainable development principles;
- To provide a structured methodology for establishing projects to improve the aesthetic quality of the installation; and
- To provide guidance to integrate anti-terrorism/force protection (ATFP) standards.

1.4 AUDIENCE

The IDG will be used by all individuals involved in decision-making, design, construction, and maintenance of Fort Hood facilities. The primary users include:

- Senior Mission Commander;
- Garrison commanders and staff;
- Installation facility planning and design personnel;
- Installation facility maintenance personnel;
- Installation management agency and region;
- U.S. Army Corps of Engineers project managers, design, and construction staff;
- Consulting planners, architects, engineers, interior designers, and landscape architects; and
- Supporting agencies such as the Army and Air Force Exchange Service (AAFES), the Defense Commissary Agency (DeCA), Department of Defense Dependents Schools (DoDDS), U.S. Army Medical Command (MEDCOM), and tenants, among others.

An effective use of landscaping and attention to pedestrian circulation. Similar standards and criteria are provided within this IDG.

The ultimate success in accomplishing the goals of the IDG is dependent upon the commitment of the above individuals and organizations working as a team to apply the standards.

Landscaping will be required throughout Fort Hood, as directed by this IDG, to provide aesthetic relief, force protection benefits, and shade.

1.5 ORGANIZATION

This IDG is organized to facilitate the preparation and execution of projects consistent with Fort Hood IDG goals and objectives (provided in Section 3). In support of these goals and objectives, the implementation of this IDG will improve the visual image on the Installation, ensure that facility design conforms to Fort Hood and U.S. Army standards, and ensure that sustainable design and development principles are implemented in a meaningful way throughout the Installation.

Sections 2 and 3 discuss the IDG use, compliance, the project approval procedure, and goals and objectives.

Section 4 establishes the Installation profile. The Installation setting, existing land use, and future land use are detailed.

Section 5 addresses the development of Installation visual themes and zones. Visual themes and zones, specific assets and liabilities of each zone, and recommendations are presented.

Section 6 presents a prioritized list of improvement projects/areas. All projects are addressed in terms of existing conditions, design and sustainable design and development concepts, order of magnitude cost estimate, funding and maintenance impact, and site plan, where applicable.

Sections 7 through 12 discuss the standards and criteria of the six main components – site planning, building, circulation, landscape, site elements, and force protection, respectively – that inform all project design, review, and analysis at Fort Hood. The standards and criteria in these sections guide all new construction and renovation projects.

Section 13 describes actions for implementation during the construction phase of the project.

Section 14 contains information related to education and operations.

Section 15 contains required permits, plans, and procedures for working at Fort Hood.

Appendices provide various types of information for completion of a design project.

Among other requirements, this IDG will specify force protection guidelines at Fort Hood such as the low barrier wall provided in this picture.

1.6 WHEN TO USE THE INSTALLATION DESIGN GUIDE

This IDG provides Fort Hood-specific design standards, criteria, and recommendations. The IDG applies to all maintenance, repair, renovation, and new construction projects regardless of the funding source. The general design concepts, recommendations, and standards addressed herein are applicable to all new construction, maintenance, renovation, and repair projects. This document will transition into an interactive web-based and database-driven IDG that will serve as the guide and main reference point to acquire Fort Hood and Army design standards and criteria. Sustainable design and development standards are included throughout all standards and criteria.

"Enhance the well-being and improve the quality of life for our soldiers, civilians, families, neighbors and community through leadership in sustainable development and design"

Fort Hood IDG Goal

1.7 MAINTAINING THE INSTALLATION DESIGN GUIDE

As a "living document," the IDG must be kept current and accurate to ensure its continued usefulness. Revisions will be necessary as mission, budget, standards, and other conditions generate new planning and design requirements as well as in response to feedback from IDG users.

In accordance with Army Regulation (AR) 210-20, Master Planning for Army Installations, the Fort Hood Real Property Planning Board (RPPB) is the adjudicating body for the IDG. Violations and variances from standards will be reviewed and adjudicated by the RPPB.

It is the responsibility of the Chief of Master Planning and Real Property Branch, Directorate of Public Works (DPW), to ensure the Fort Hood IDG is maintained and updated on a regular basis. Updates will occur based on input from various branches and divisions within each respective directorate at the Installation. For example, the Environmental Division's Energy Team should ensure that all current and up-to-date information related to their department or area of responsibility is provided to the Chief of Master Planning. The Chief of Master Planning will then follow through to ensure the updated information is reflected in the IDG. Because hard copy editions of "living documents" often become outdated in relatively short periods of time, an interactive web/data-based IDG has been prepared that will afford Fort Hood the ease of updating the document and incorporating new design requirements as conditions and technology change. Thus, the user of this document should be aware the Fort Hood IDG hard copy will not

Metal roofing, such as the material used in here, is a Fort Hood requirement.

be updated` as often as the interactive web/data-based IDG. For information on how to access the web/data-based IDG, please contact the office of the Chief of Master Planning: 254-287-3528.

Photo: George Marsh, ©/DOE/NREL.

The use of photovoltaic (PV) technology, such as the PV solar array installed at Marina Del Rey USPS Postal Station in Los Angeles, will be considered in the overall building design process at Fort Hood.

1.8 RESPONSIBILITIES

As directed by the Secretary of the Army, and the Chief of Staff Army, and approved by the Army Installation Management Board of Directors, the following responsibilities are established:

Assistant Chief of Staff for Installation Management:

- Establish Army facility standards and approve deviations from the standards;
- Approve Army Installation Design Standards Implementation Plan; and
- Approve Army Installation Design Standards Investment Strategy.

Director Installation Management Agency (Dir IMA):

- Develop and implement the Army Installation Design Standards Implementation Plan;
- Develop and implement the Army Installation Design Standards Investment Strategy;
- Ensure compliance with the Army Installation Design Standards; and
- Maintain electronic newsletter for communicating changes in standards.

Garrison Commander:

- Develop Fort Hood's IDG;
- Chair RPPB to review and approve projects established on the Prioritized Improvement Projects List (see Section 6: Improvement Projects);
- Submit Prioritized Improvements Projects List/Areas for approval and funding in accordance with Director IMA instructions after review and approval by Senior Mission Commander; and
- Enforce Fort Hood IDG standards.

Senior Mission Commander:

- Review and approve Fort Hood IDG; and

- Review and approve RPPB prioritized improvement projects list recommendations to meet Army standards prior to submission to IMA Region Director.

Major Army Command/Tenant:

- Participate in the Fort Hood RPPB;
- Participate in design and planning charrettes;
- Determine project's functional requirements;
- Participate in design reviews; and
- Participate in development of Prioritization Projects List.

1.9 SUSTAINABLE DESIGN AND DEVELOPMENT

The Fort Hood IDG provides sustainable design concepts for energy efficient and environmentally sound buildings as well as for everyday operations and maintenance practices at Fort Hood. The intent of the sustainable design and development requirements and recommendations is to improve the environmental performance, cost-effectiveness, and health of the natural and built environments at Fort Hood for all users. This in turn supports the mission of Fort Hood.

1.9.1 WHAT IS SUSTAINABLE DESIGN?

Sustainable design and development is an integrated approach to planning, designing, building, operating, and maintaining facilities in a collaborative and holistic manner among all stakeholders. Sustainable design integrates the decision-making across the installation, basing every decision on the greatest long-term benefits and recognizing the interrelationship of installation actions with the natural environment. In the context of Army installations, sustainable design is the design, construction, operation, and reuse/removal of the built environment in an environmentally and energy-efficient manner. The basic objectives of sustainability are:

- Reduce the consumption of energy, land, materials, water, and other non-renewable resources;
- Minimize the waste of energy, land, materials, water, and other limited resources;

- Protect the natural environment that is the source of all resources;
- Create livable, healthy, and fiscally productive manmade environments for existing and future generations; and
- Design for sustainability. Designing for sustainability ultimately increases quality of life through better resource protection and use. The design process must incorporate a change in mind-set that embraces less consumptive lifestyles. This mind-set change must include global interdependence, stewardship of the environment, social responsibility, and economic viability. The new design mind-set must change from the traditional approach to recognize the impacts of every design choice on natural and cultural resources and on local, regional, and global environments.

Practicing the principles of sustainable design in the planning, design, construction, and operation of infrastructure and facilities is a smart business practice. Protecting our natural resources and reducing our impact on the natural environment is achievable when we create energy-efficient, healthy, high-performance, and safe buildings.

1.9.2 The Integrated Design Process

The organization and commitment of the Design Team to engage in the Integrated Design Process is critical to the success of sustainable design and development. To effect change in building design and operation, the project delivery process itself must become a collaborative effort to integrate design strategies among all disciplines and all players in the project delivery process. Integrated design demands a more inclusive team, working closer together than is traditionally the case. Future building users and facility managers must be invited to join architects, engineers, and planners in developing the vision.

Fort Hood uses a planning and design charrette process to engage participants in the design process. This process is more fully described in Section 2.3.4 of this IDG (Also see Engineering and Construction Bulletin Numbers 2002-13 and 2002-16, USACE).

1.9.3 SUSTAINABILITY AND THE FEDERAL GOVERNMENT

The Federal Government has led the nation in energy-efficient, resource-conserving building design, construction, and operation. On January 24th, 2007 President George W. Bush signed Executive Order (EO) 13423, "Strengthening Federal Environmental, Energy, and Transportation Management." The order sets goals in the areas of energy efficiency, acquisition, renewable energy, toxics reductions, recycling, renewable energy, sustainable buildings, electronics stewardship, fleets, and water conservation. EO Section 2-f states: "ensure that (i) new construction and major renovation of agency buildings comply with the Guiding Principals for Federal Leadership in High Performance and Sustainable Buildings set forth in the Federal Leadership in High Performance and Sustainable Buildings memorandum of Understanding (2006, and (ii) 15 percent of the existing Federal capitol asset building inventory of the agency as of the end of fiscal year 2015 incorporates the sustainable practices in the Guiding Principles."

In addition, EO 13123 *Greening the Government through Efficient Energy Management* was issued 03 June 1999. This Order establishes that sustainable design principles that shall be applied to all federal projects in order to reduce pollution and other environmental costs associated with facility construction, operation, and eventual decommissioning. The principles of sustainable design for federal agencies established by EO 13123 include siting, design, and construction, as follows (also see Figure D-1):

- **Site**. Optimize site potential;
- **Energy**. Minimize nonrenewable energy consumption;
- **Materials**. Use environmentally preferable products;
- **Water**. Protect and conserve water;
- **Indoor Environmental Quality**. Enhance indoor environmental quality;
- **Facility Delivery**. Holistic delivery of facility;
- **Operations and Maintenance (O&M).** Optimize operational and maintenance practices; and
- **Future Missions**. Functional life of facility and support systems.

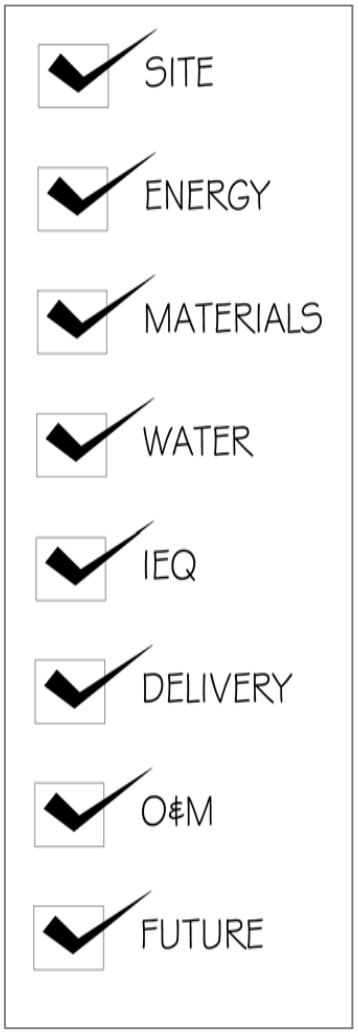


Figure D-1 Sustainable Design Principles

1.9.4 Leadership in Energy and Environmental Design (LEED)

In a 5 January 2006 memorandum, the Assistant Secretary of the Army for Installations and Environment announced that the Army will transition from the Sustainable Project Rating Tool (SPiRiT), in use since 2002, to the Leadership in Energy and Environmental Design (LEED) Green Building Rating System effective with the FY08 Military Construction Program.

All military vertical building construction projects starting with the FY 08 military construction program will achieve the SILVER level of LEED-NC (New Construction). This policy includes all new construction projects, regardless of fund source. Horizontal construction, such as ranges, roads, and airfields, will continue to incorporate Sustainable Design and Development features to the maximum extent possible. The installation Director of Public Works or the Reserve Component equivalent, supporting Engineer District, designer and constructor will jointly certify the final LEED score and rating.

For maintenance projects, Fort Hood encourages the consideration of the LEED – Existing Buildings (EB) rating system when designing, planning, or conducting maintenance or rehabilitation projects on existing buildings at Fort Hood.

While the USGBC has not yet finalized nor has the US Army adopted LEED-Homes as its standard for new residential construction, Fort Hood will use this system for rating all Army Family Housing new construction projects and homes built under the Residential Communities Initiative. A level of SILVER will be strived for. The Army will adopt LEED Homes for scoring residential housing when released by the USGBC.

LEED NC, EB, and HOMES checklists are included in Appendix D. For more information on LEED visit the U.S. Green Building Council website at www.usgbc.org or contact the Fort Hood LEED Coordinator, DPW – Environmental at (254) 287-6499 for more information.

1.9.5 Sustainability and Project Design

It is expected that by studying the individual sustainable requirements and recommendations, how they interrelate, and the questions to be considered for their application, the design professionals will be able to design projects consistent with the goals of this IDG (Section 3) and that meet the requirements of the Leadership in Energy and Environmental Design (LEED) standards developed by the United States Green Building Council (USGBC). The LEED rating of “Silver” is the standard for Fort Hood.

What is LEED®?

The Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ is the nationally accepted benchmark for the design, construction, and operation of high performance green buildings. LEED gives building owners and operators the tools they need to have an immediate and measurable impact on their buildings’ performance. LEED promotes a whole-building approach to sustainability by recognizing performance in five key areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality.

For more information on LEED visit http://www.usgbc.org/.

The design guide requirements presented in Sections 7 through 14 apply to a wide range of projects and building types. It is not the intent, nor even practical, for the IDG's sustainable design principles to provide the "end-all" for a comprehensive, holistic design for each project or building at Fort Hood. In the "whole building" design process, a designer must understand all the factors affecting a building from building orientation to building envelope; glazing; lighting; and heating, ventilation, and air conditioning (HVAC) systems. To understand the energy performance of a building, the designer must understand how all these factors interrelate. Computer or building simulation tools are an essential component of the whole building design process. Building simulation is discussed at the beginning of Section 8.14.

Numerous geothermal wells have been installed under this lawn to help cool and heat the DPW building.

The response should be provided within the context of the four principles adopted by Fort Hood: function, cost, aesthetics, and environmental impact for each project or building. Because technologies for the advancement of sustainable practices change, Fort Hood supports the designer bringing forth new ideas that meet the goals and objectives stated in Section 3.

The use of compressed-straw panels for building materials at Fort Hood.

Further information on sustainable design can be obtained at the following websites:

- **Assistant Chief of Staff for Installation Management,** Sustainable Design and Development Website (http://www.hqda.army.mil/acsimweb/fd/linksSDD.htm). This site provides information on the following topics: documentation and references; sustainable process, tools, products and materials; Sustainable Design and Development Training; and links to various sustainable design and development informational websites.

- **U.S. Army Corps of Engineers,** Engineering Research and Development Center, Construction Engineering Research Laboratory (CERL), Sustainable Design and Development Website (http://www.cecer.army.mil/sustdesign).

- **Whole Building Design Guide (WBDG).** (http://www.wbdg.org/). This site provides comprehensive and current information on sustainable design strategies and technologies.

- **U.S. Green Building Council (USGBC).** (http://www.usgbc.org/). This site provides information and resources to promote the design and construction of buildings that are environmentally responsible and healthy places to live and work.

1.10 BUILDING LIFE-CYCLE COST ANALYSIS

The use of life-cycle cost analyses (LCCAs) for buildings designed to incorporate sustainable systems and features is an important process for obtaining approval of a design with greater upfront capital investment costs. Cost analysis should be done early in the planning process to determine if processes would be beneficial to the overall project.

Section 401 of Executive Order (EO) 13123 requires that "Agencies shall use life-cycle cost analysis in making decisions about investments in products, services, construction, and other projects to lower the Federal Government's costs and to reduce energy and water consumption."

LCCA is a comparative method whereby all costs and savings related to a decision are evaluated over a common study period and adjusted for the time value of money. Since LCCA incorporates the time value of money on costs and savings over a given study period, LCCA differs from the commonly used "simple payback" method. LCCA is especially useful when various project alternatives that fulfill the same performance requirements but differ with respect to initial costs and operating costs must be compared in order to select the one that maximizes net savings.

Lowest life-cycle cost (LCC) is the easiest measure of economic evaluation to interpret. Some other commonly used measures are Net Savings (NS), Savings-to Investment-Ratio (SIR [or Savings Benefit-to-Cost Ratio]), and Internal Rate of Return (IRR).

The Building Life-Cycle Cost Program BLCC 5.2-04 developed by the National Institute of Standards and Technology (NIST) provides economic analysis of proposed capital investments expected to reduce long-term operating costs of buildings or building system/components. BLCC is especially useful for evaluating the costs and benefits of energy conservation projects in buildings.

Life-cycle costs are defined as "the sum of present values of investment costs, capital costs, installation costs, operating costs, maintenance costs, and disposal costs over the

BLCC 5.2-04 is capable of providing LCCA analyses for the following project components that should be considered when evaluating the life-cycle costs for projects at Fort Hood:

- The initial cost of equipment;
- Anticipated maintenance expenses;
- Projected energy costs;
- Projected energy and labor cost escalation rates; and
- Replacement costs.

LCCA can be applied to any capital investment decision in which relatively higher initial costs are traded for reduced future obligations. It is particularly suitable for the evaluation of building design alternatives that satisfy a required level of building performance but may have different operating and maintenance and repair costs.

LCCA can be performed at various levels of complexity. The extensiveness of the effort should be tailored to the needs of the project.

The designer should conduct LCCA in the design process according to *Sustainable Federal Facilities: A Guide to Integrating Value Engineering, Life-Cycle Costing, and Sustainable Development* (Federal Facilities Council 2001). The LCCA should be performed early in the design process to refine the design and ensure a reduction in life-cycle costs. The use of simple payback should be restricted to that of a screening tool.

Photo: Steve Hall and Henrich Blessing, ©/DOE/NREL.

The Nidus Center for Scientific Enterprise, located in St. Louis, Missouri, has many sustainable, high-performance features, including a flexible layout; self-sustaining landscaping; extensive use of daylighting; an efficient mechanical system with energy recovery; extensive use of local materials; material containing relatively low amounts of volatile organic compounds (VOCs) and those with a high recycled content; and water conservation. As part of Fort Hood's building life-cycle cost analysis, consideration and review of these same high performance features will occur for major renovation and new construction projects.

Whenever a sustainable, proven, technology can be supported through a LCCA (i.e., the life-cycle cost is less), Fort Hood requires the use of the technology. If the LCCA shows a slight increase in cost for using a sustainable technology, the environmental benefits of using the technology shall be submitted to the charrette team for consideration and their recommendation on the use of the technology. Expensive technologies with minimal environmental benefit are not approved for use at Fort Hood.

According to U.S. Department of Defense (DoD) Directive 5000.1, Defense Acquisition System, corrosion prevention control and mitigation will be considered during life-cycle cost tradeoffs. Consideration of operational and logistics capabilities (such as readiness, reliability, sustainability, and safety) is critical to ensure the effectiveness of a system or facility, and is best accomplished during conceptual design, when the effects of corrosion on these capabilities should be addressed.

1.11 REFERENCES

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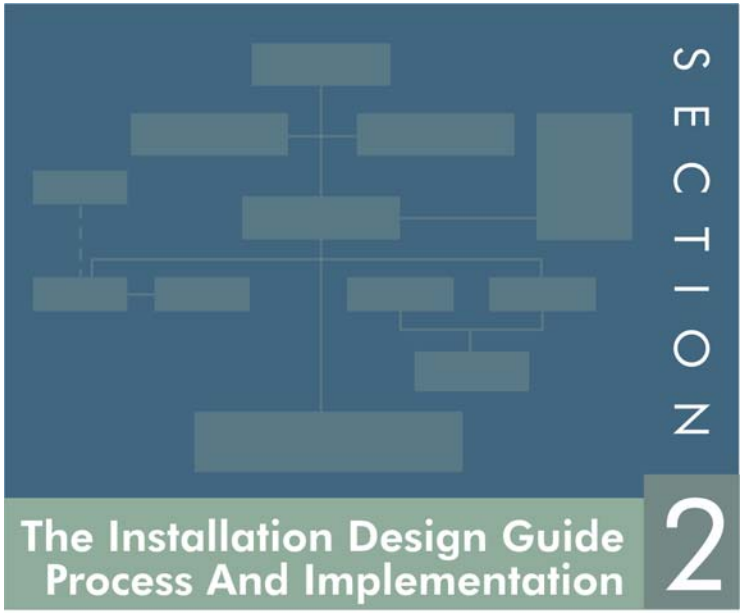
- U.S. Green Building Council (USGBC), http://www.usgbc.org.



Fort Hood's Fisher house is a home away from home for families who have loved ones in Darnell Hospital.

The Fort Hood IDG provides direction for achieving a sense of community, order, tradition, and pride. It is also the main implementation tool for integrating sustainable development and design into all new construction, renovation, and maintenance projects. This section provides a brief overview of the IDG developmental process and methodology detailed in Unified Facilities Criteria (UFC) 2-600-01, Installation Design.

2.1 THE DESIGN GUIDE PROCESS

The Installation Design Standards for development of an IDG include a process for analysis, planning, design, and implementation. This process, as used in the preparation of this IDG for Fort Hood, involves the following steps:

1. Goals and Objectives. The installation develops goals and objectives for the IDG that address the installation's visual and sustainable design and development requirements. The goals and objectives provide a pre-determined image that helps create a visually pleasing and optimally functional environment. The goals and objectives for Fort Hood can be found in Section 3.1.1 and 3.1.2, respectively.

2. Visual and Spatial Surveys. Two visual surveys are performed in the preparation of the IDG. To effectively conduct the visual survey assessment, the survey team must understand the application and interactions of design principles (see Section 3.3), visual elements (see Section 3.4), and design components, which include site planning, buildings, circulation, landscape, site elements and force protection. Chapter 5 of UFC 2-600-01 details the method for conducting the installation visual surveys.

The first visual survey establishes the visual zones and themes of the installation. The second survey documents the assets and liabilities within each visual zone. The results of the visual surveys for Fort Hood can be found in Section 5 of this IDG.

Liability

Asset

Surveys were used to capture visual assets and liabilities at Fort Hood.

3. Delineation of Visual Zones and Themes. The information gathered during the first survey is used to establish the visual zones of the installation. The visual zones are delineated by the visual characteristics of an area defined as the "look and feel" of an area together with the dominant features that help define its image. A functional analysis of each zone organizes the visual impressions and assesses their functional relationships to determine the visual character and unifying motif. Typical visual characteristics include unique buildings, vehicular and pedestrian corridors, functional use, natural features, and spatial relationships. Visual zones with similar characteristics are then grouped to form a broader category called themes (see Section 5).

4. Determination of Assets and Liabilities. The objective of this inventory is to define the visual assets and liabilities within the visual zone. *Assets* are positive visual elements, design elements, or features that enhance the surroundings, either visually or functionally. *Liabilities* are negative visual elements, design elements, or features that detract from the visual image or functionality of the surroundings. Liabilities should be corrected through appropriate design measures and are the basis for recommendations for improvement.

5. Recommendations and Implementation Plan. The assessment of each visual zone includes recommendations to correct liabilities and, where desired, to enhance assets (see Section 5). The recommendations provide the basis for Section 6 "Improvement Projects" of the IDG. As used in this IDG, priority improvement projects (PIPs) can be areas designated for improvement in accordance with the design requirements of the IDG.

2.2 FORT HOOD IDG IMPLEMENTATION

2.2.1 Fort Hood IDG Review and Approval

To ensure the Fort Hood IDG has a broad spectrum of input, various directorates and their respective divisions and branches review it. These include Community Activities, Information Management, Logistics, Plans Training and Security, and Public Works. Final Fort Hood input and approval is provided by the Garrison Command.

2.2.2 Compliance

For the Fort Hood IDG to function optimally as a management tool, it is essential the Chief of Master Planning or designated representative establish an understanding of the IDG among the parties concerned with its use. The Chief of Master Planning, or designated representative, will ensure the requirements and recommendations of the Fort Hood IDG are readily available and understood by all parties involved in the design of new facilities, design of additions or alterations to existing facilities, or maintenance.

Photo: Robb Williamson, ©DOE/NREL.

Compliance with Fort Hood's IDG requirements will facilitate the construction of high performance buildings, such as the Chesapeake Bay Foundation's (CBF) Philip Merrill Environmental Center, to help sustain the mission, environment and community. In this illustration, a rain catchment system captures rainwater for use in fire suppression, and in the building's sinks.

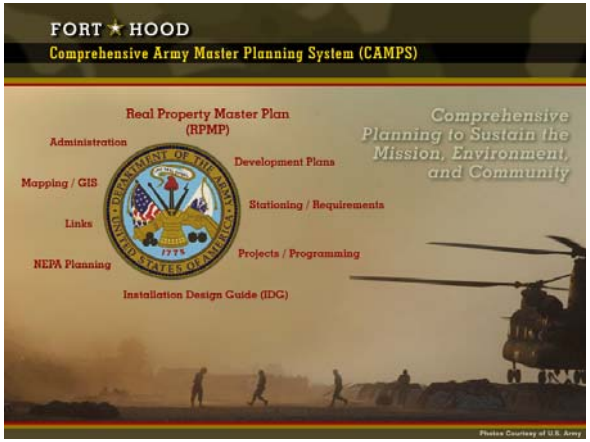
The Chief of Master Planning or designee, acting in support of the Real Property Planning Board (RPPB), is the first level reviewer of projects (Sustainment, Restoration, and Modernization [SRM]; Military Construction, Army [MCA]; and non-appropriated fund [NAF], to include Design Build) and other requests for actions that involve compliance with IDG guidelines and standards. The Garrison Commander, supported and advised by the RPPB, is the final authority in enforcement of the IDG guidelines and standards.

The Executive Planning Board, chaired by the Senior Mission Commander, will monitor development of the installation planning process and provide guidance to other installation boards and the Garrison Command for areas such as:

- Strategic Planning;
- Real Property Planning;
- Range Planning; and
- Communications Planning.

2.2.3 Web-based IDG

The Fort Hood IDG is provided in two distinct formats. One format is in hard copy and enclosed in a traditional binder. The hard copy format follows the main structure established by the Army for use by installations when completing their respective IDGs. An electronic version of this hard copy format is also provided and may be obtained from the Fort Hood Directorate of Public Works.



The web-based IDG can be found on Fort Hood's CAMPS website.

The second format is a web-based/automated version that contains the standards and criteria found in the hard copy Fort Hood IDG. The web-based/automated version can be found on Fort Hood's Comprehensive Army Master Planning System (CAMPS) website. This format is different from the traditional hard copy document in that design standards can be queried and retrieved based on user input. That is, the web-based IDG permits the user to select the project type, location (which identifies the visual zone) or a visual zone, and Facility Category Group to retrieve specific design standards that must be followed for a particular project. The design standards contained on the web-based IDG were derived from the hard copy IDG.

2.3 PROJECT DEVELOPMENT AND THE IDG

2.3.1 Construction, Renovation, and Maintenance Projects

This IDG guides all planning, programming, design, construction, renovation, and maintenance of all facilities on Fort Hood. The standards contained within the IDG will be incorporated into all projects originating at Fort Hood and will be incorporated in Military Construction (MILCON) projects and MILCON Transformation (MT) requests for proposal (RFPs) consistent with project budgets, life-cycle cost, and sustainable design and EPACT 2005 requirements.

The IDG applies to all facility projects on Fort Hood.

All project requests, to include Department of Defense (DD) Form 1391 "Military Construction Project Data" and the Department of Army (DA) Form 4283 "Facilities Engineering Work Request" will be submitted to the DPW Engineering Division Program Manager. DA Form 4283 is the prescribed form for obtaining services from the Directorate of Public Works (DPW). It is used for the control and

management of Real Property Facilities placed under the responsibility of the DPW. DD Form 1391 is the justification and programming form for major construction projects. It includes project location, scope, cost, economic alternatives, and other necessary information for the decision makers.

2.3.2 Self-Help and Occupant-Purchased and Installed Site Furnishings and Feature Projects

The Self-Help Program is a continuous effort to preserve facilities in an acceptable state of repair and appearance by allowing individuals, units, and organizations to perform specific maintenance, repair, and minor construction (e.g., gazebos, outbuildings) with assigned personnel. The program can assist the facility users to improve their working or living environment and the performance of their mission. Self-help projects must be submitted to the DPW for approval before the project is initiated. DA Form 4283 is required. For additional information on Fort Hood's Self-Help Program see Fort Hood Regulation 420-27 Care, Maintence and Alterations of Facilities or contact 254-287-7129 or 254-287-9813. The following steps illustrate the self-help project approval process:

Step 1: Applicant contacts the DPW Engineering Division Program Manager (254-287-7129 or 254-287-9813) to have a project added to the project review list. The Project Review Board reviews these projects every Wednesday at 0900 in Building 4612, Conference Room 2.

Step 2: Applicant attends the project review meeting and provides 15% design sketch to the Board for their review for larger projects and 50% design sketch for smaller projects. The Board provides comments to the applicant. (The Step 2 process occurs at the 15%, 65%, and 95% design level for larger projects and at the 50% and 95% design level for smaller projects.)

Step 3: The applicant addresses comments and revises the documents at each detailed design level described in Step 2. The Board reviews the drawings to ensure all comments have been addressed.

Step 4: The Chief of Master Planning issues an approval for the project.

2.3.3 Military Construction (MILCON) Transformation

Military Construction (MILCON) Transformation is an Office of the Assistant Chief of Staff for Installation Management (OACSIM) and U.S. Army Corps of Engineers (USACE) strategy to transform the Army's capital construction process to provide quality facilities faster, better, cheaper, greener and safer with lower operating costs. MILCON Transformation depends on standardized facilities (see Section 2.3.2.1: Army Facilities Standardization Program below) but also changes the Request for Proposal (RFP) process from prescriptive requirements to more performance-based criteria. The criteria will help ensure that new Army MILCON projects meet the mandates of the Energy Policy Act of 2005.

MILCON Transformation does not forego the previous mandates on new construction. Projects constructed beginning in FY 2008 must achieve a LEED silver rating. In addition, MILCON Transformation projects must still encompass the building performance and operational requirements set forth in Army standards that have been approved by the Army Facility Standardization Committee. Lastly, MILCON Transformation incorporates the local architectural and functional requirements identified in this Installation Design Guide (IDG).

2.3.3.1 Army Facilities Standardization Program

The overall objective of the standardization program is to provide quality facilities that consistently include the fundamental features, components, and criteria required by the Army for real property of the same facilities category code (i.e. barracks, company operations facilities, etc.). The design of each facility has been assigned to a Center of Standardization, which is responsible for the development of standards for each identified facility type. The Centers, facility type, and contact information is provided in the table below.

Army Facilities Standardization Program Centers of Standardization	
Assigned Center	**Facility Type**
U.S. Army Engineering and Support Center, Huntsville **Attn: CEHNC-ED-CS-A and IS** **P.O. Box 1600** **Huntsville AL 35807** **Telephone: 256-895-1673/1672/1535** **http://www.hnd.usace.army.mil/**	Child Development Center-Infant/Toddlers
	Child Development Center Playground
	Child Development Center – 6 to 10 Year Olds
	Physical Fitness Facilities
	Fire Station
	Hazardous Material Storage Facility
	Outdoor Sports Facility
	Close Combat Tactical Trainer (CCTT)
	Urban Assault Course (UAC) *replaces: Military Operations Urban Terrain (MOUT)*
	Training Range
	Youth Activity Center
	Bowling Center (RFP)
	Army Community Service Centers
	Consolidated Fire/Police/Safety Facility
U.S. Army Engineer District, Louisville **ATTN: CELRL-ED-D-A** **600 Martin Luther King Jr. Place** **Louisville, KY 40202 Tel: 502-315-6250** **http://www.lrl.usace.army.mil/**	Army Reserve Center
U.S. Army Engineer District, Norfolk **ATTN: CENAO-TS-EA** **803 Front Street** **Norfolk, VA 23510** **Telephone: 757-441-7702** **http://www.nao.usace.army.mil/**	Classroom XXI
	Criminal Investigation Facility (CIDC)
	Enlisted Personnel Dining Facility
	Family Housing (RFP)
	General Instruction Building
	Information Systems Facility
	Troop Issue Subsistence Activity Facility (TISA)
	Central Issue Facility

Army Facilities Standardization Program Centers of Standardization	
Assigned Center	**Facility Type**
	General Purpose Warehouse
U.S. Army Engineer District, Omaha **ATTN: CENWO-ED-DG/PM-M** **215 North 17th Street** **Omaha, NE 68102** **Telephone: 402-221-4552/443** **http://www.nwo.usace.army.mil/**	Army Chapel
	Chapel Family Life Center
	Religious Education Facility
	Small Site Chapel
	Access Control Points
	Airfields, Railroads, Pavements, Bridges, and Dams
U.S. Army Engineer District, Mobile **ATTN:CESAM-PM-SI** **P.O. Box 2288** **Mobile, AL 36652-2288** **Telephone: 251-394-3600** **http://www.sam.usace.army.mil/**	National Guard Armory
U.S. Army Engineer District, Savannah **ATTN: CESAS-EN-E** **P.O. Box 889** **Savannah, GA 31402** **Telephone: 912-652-5212** **http://www.sas.usace.army.mil/**	Company Operations Facility (COF)
	Military Entrance Processing Station (MEPS)
	Tactical Equipment Maintenance Facility (TEMF)
	Unaccompanied Enlisted Personnel Housing (UEPH), New and Modernization
	One Station Unit Training (OSUT) Barracks
	Unaccompanied Officer / Sr. Enlisted / Quarters
	Unaccompanied Officer Quarters, Transient
	Brigade / Battalion HQ
	Operational Readiness Training Complex (ORTC)
	Deployment Facility
	Advanced Individual Training (AIT) Barracks *
	Basic Combat Trainee (BCT) *

Army Facilities Standardization Program Centers of Standardization	
Assigned Center	**Facility Type**
U.S. Army Engineer District, Tulsa **ATTN: CESWT-EC-D** **1645 S. 101ST East Avenue** **Tulsa, OK 74128** **Telephone: 918-669-7033** **http://www.swt.usace.army.mil/**	Advanced Individual Training (AIT) Barracks * Basic Combat Trainee (BCT) * Reception Barracks
Community and Family Support Center (CFSC) **Telephone: 703-681-1506** **http://www.armymwr.com/portal/about/#cfsc**	Army Lodging Clubs/Food, Beverage and Entertainment (FBE) Facilities Golf Courses Recreational Lodging

*AIT and BCT to be transferred to Savannah, upon completion by Tulsa.

2.3.3.2 Process for Including IDG Requirements in Model RFP

Headquarters, US Army Corps of Engineers (USACE), in coordination with garrison commanders, will ensure IDG requirements are incorporated in MILCON projects and MILCON Transformation (MT) requests for proposal (RFPs) consistent with project budgets, life-cycle cost, and sustainable design and EPACT 2005 requirements. All MILCON projects will fully embrace and incorporate Army Standards, Standard Designs, and Installation Design Guides. The process for including IDG requirements in Model RFPs is illustrated in Figure 2-1.

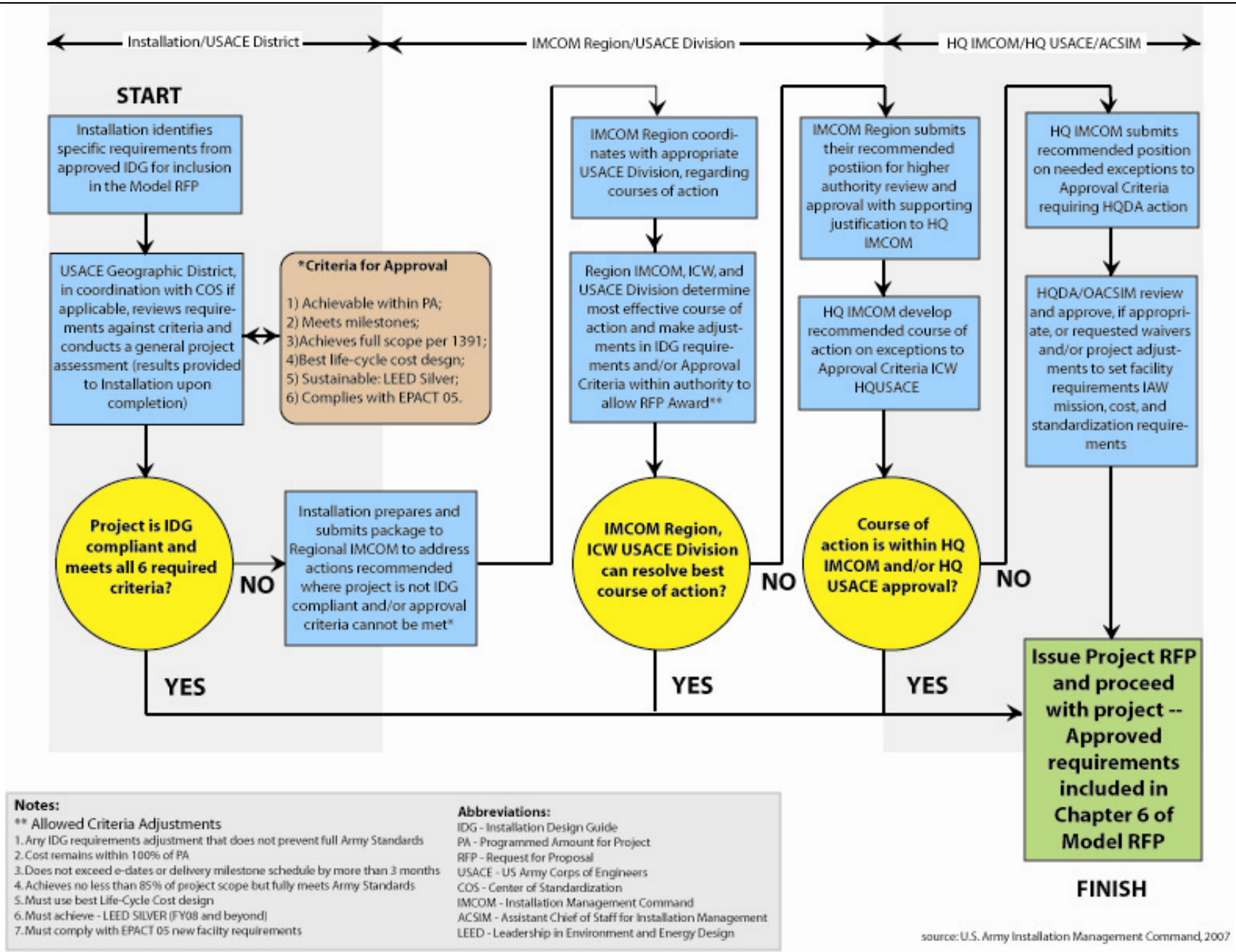


Figure 2-1 Process for Including IDG Requirements in Model RFP

2.3.4 Planning and Design Charrettes

Within the Master Planning Division at Fort Hood, questions related to the charrette process and the scheduling of charrettes should be directed to: 254-287-3528.

Planning Charrette. At Fort Hood, a project starts with a draft DD Form 1391 ready for the Garrison Commander's signature. DD Form 1391 is an important part of the planning charrette process. This is the first in a series of charrettes to complete the project. Participants of the planning charrette vary by the project, but at Fort Hood typically include the building user/customer, Directorate of Information Management (DOIM), Director of Aviation Operations, Provost Marshal, Fire Department, Force Protection Officer, Antiterrorism, Industrial Hygiene, Fire Marshal, and DPW staff to include a National Environmental Policy Act (NEPA) staff member. Participants are informed of the date of the charrettes by e-mail two weeks prior.

The purpose of the planning charrette is to identify and consider all the requirements for the project, including primary and supporting facilities that affect the design and implementation components of the project. Issues may include but are not limited to fire, communication, industrial hygiene, air space, force protection, electrical codes, and others. The LEED checklist (Appendix D) is filled out during the planning charrette phase and at the end of the charrette process there is a LEED Point Rating Summary. The DPW and the U.S. Army Corps of Engineers (USACE) provide input to achieve the required LEED rating.

At the end of this planning charrette process there is a complete and accurate DD Form 1391. Upon completion of DD Form 1391, Garrison Commander signs the DD Form 1391 and it is then submitted to IMA.

Design Charrette. Once DD Form 1391 is completed, approved, and signed, the installation gets a design directive to go forward with project design. A design charrette is held to identify the 15%, 35%, 65%, and 95% detail design sequences. From this point, the project is sent for bid and award. At each detailed design sequence, the project is sent through a design review (formal) and the Project Review Board (informal) to ensure compliance. The Project Review Board meets weekly at 0900 in Building 4612, Conference Room 2.

2.4 MASTER PLANNING RESPONSIBILITY

The Chief of Master Planning will provide to the Designer of Record or the Design Agent, design information that has been finalized through the design process. This information represents the design requirements of the project with which the Designer of Record or Design Agent must comply.

First, the Chief of Master Planning will provide a Project Design Checklist (Appendix B) to the design team that will eventually be the Designer of Record or Design Agent. The Project Design Checklist will be used as a pre-design planning tool for initiating projects and to present a functional description of the project at Military Construction (MILCON) Planning Charrettes and Design Charrettes.

Second, the Chief of Master Planning will provide to the design team the IDG standards and requirements derived from this IDG. These design/construction requirements will be prepared by the Chief of Master Planning for distribution to all appropriate divisions prior to the first planning charrette. At the first charrette, each division will be responsible for ensuring that the requirements for their areas of responsibility are reflected.

Once both design checklists are complete, they will become part of the overall design packages submitted to the Designer of Record or Design Agent. It is important for the A/E who prepares the RFP to remember that the specific guidance must be contained in both design checklists to get what is needed for the project.

Designer of Record or Design Agent Responsibility

All completed design projects must include a completed **Design Team IDG Checklist** (IDG Checklist; Appendix A). This will be completed by the Designer of Record or Design Agent for the design of new facilities, additions, or renovations to existing facilities, or maintenance on the installation. For MILCON projects, a copy of the completed checklists, together with a signed certification statement is required with each design submittal (10% [pre-concept], 35%, 60%, and 90% for each MILCON project). The Chief of Master Planning will provide the IDG Checklist to the design team for completion.

In the case of design build, all agents (i.e. the U.S. Army Corps of Engineers, Non-appropriated Funds (NAF) tenants, Army Air Force Exchange Service (AAFES), and other tenants, etc.) shall have the perspective design build contractors submit a completed IDG Checklist as part of their proposal. The completed checklist will be provided to the Chief of Master Planning for review with concurrence or

denial. Upon a determination of concurrence by the Chief of Master Planning, the plan and checklist with signatures will then be provided to the Real Property Planning Board for final acceptance or denial. The accepted checklist will become a part of the project record files.

If plans are denied for non-compliance at the installation or command level of review (where applicable), an explanation of the denial will be provided to the Designer of Record. The plan and checklist can be resubmitted with revisions as indicated in the explanation of denial.

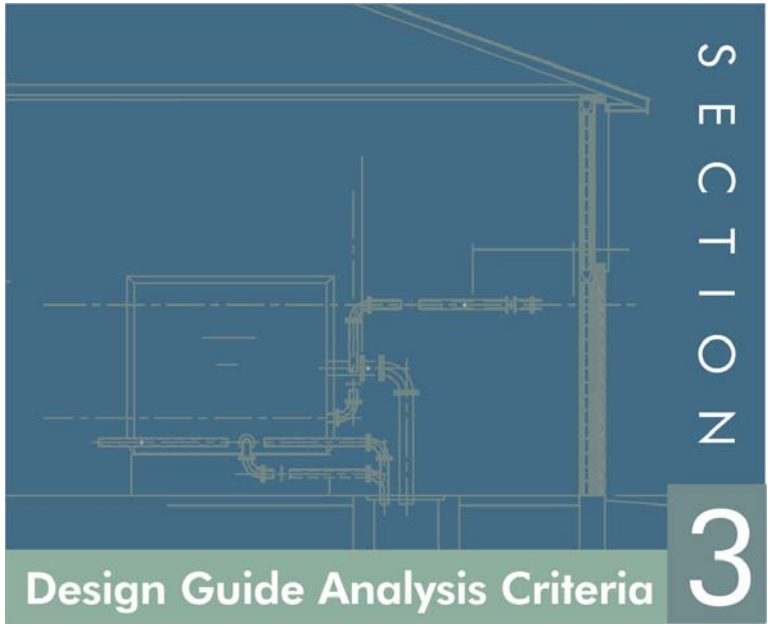
Waiver Request. A request of waiver from the IDG Checklist (Appendix A) must be submitted to the Chief of Master Planning office for approval by the RPPB when an applicant cannot meet a specific standard or requirement provided in the IDG. A request for waiver from the Army standards shall be submitted to the Assistant Chief of Staff for Installation Management for approval.

As mentioned in Section 1.9 "Sustainable Design and Development," for those sustainable design and development project element requirements provided by the Chief of Master Planning to the designer, that are not part of the design for the project, the designer is required to provide a written response as to the reason for not using the requirement.

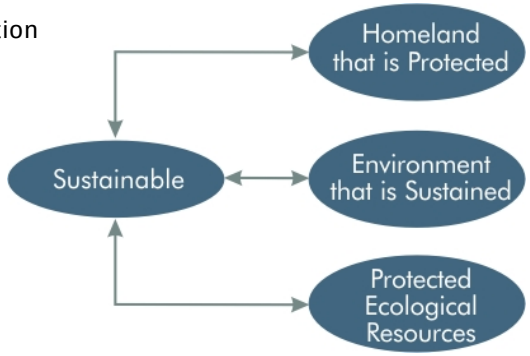
2.5 REFERENCES AND RESOURCES

- Design Charrettes, http://www.hnd.usace.army.mil/techinfo/ECB/ECB%202002-13%20(Rev.%202).pdf
- Planning Charrettes, http://www.hnd.usace.army.mil/techinfo/ECB/ECB%202002-16.pdf
- Department of Army (DA) Form 4283, Facilities Engineering Work Request, http://www.dpw.hood.army.mil/Files/ENV/ecat/FH420-27.pdf
- Department of Defense (DD) Form 1391, Military Construction Project Data, http://www.hnd.usace.army.mil/pao/FactShtsFY04/dd1391-04.pdf
- Fort Hood Regulation 420-27 Care, Maintence and Alterations of Facilities, http://www.dpw.hood.army.mil/Files/Downloads/FH420-27.pdf

- UFC 2-600-01, Installation Design, http://knxas1.hsdl.nps.navy.mil/homesec/docs/dod/nps03-080504-01.pdf and Chapter 5 of UFC 2-600-01, http://knxas1.hsdl.nps.navy.mil/homesec/docs/dod/nps03-080504-01.pdf



The IDG process depends upon the development of visual goals and objectives and the identification of visual elements. The developed goals and objectives provide a desired end-state for the visual elements (e.g., buildings) and sustainable design practices for the installation. They are also used to help establish design principles (e.g., colors, scale), which are used to assess, define, and classify existing visual elements (see Section 5). This assessment is then used to help establish the design criteria found in Sections 7 through 13 of the IDG. The design criteria of this IDG will be used to guide visual character and sustainable development practices for all new construction, renovation, maintenance, and repair projects at Fort Hood.



3.1 IDG GOALS, OBJECTIVES, AND RECOMMENDATIONS

The Fort Hood IDG goals and objectives set the desired visual context of the installation while also providing for the integration of sustainable design and development. Although broad in nature, they support the Army goals identified in Section 1. The objectives are more definitive and provide specific actions necessary to attain the goals. Both the goals and objectives provide the overall direction for the development of the Fort Hood IDG.

"Strengthen Fort Hood operational capacity by reducing our environmental footprint through more sustainable development and design practices"

Fort Hood IDG Goal

Photo: Robb Williamson, ©DOE/NREL.

Using proven sustainable technologies, such as those used at Oberlin College's Adam Joseph Lewis Center for Environmental studies, Fort Hood is requiring a number of energy efficient and environmentally friendly features to be considered during the building design and construction process. The building in this figure has 4,682 square feet of photovoltaic panels, closed-loop geothermal wells that provide heating and cooling, daylighting, and a Living Machine—an engineered wastewater treatment system modeled on natural wetland ecosystems. Designers were also careful to use products and procedures to maintain a high indoor air quality, and materials are durable, recyclable, and low-maintenance.

3.1.1 Fort Hood Installation Design Guide Goals

"Integrate sustainable design and development concepts into all standards and criteria"

Fort Hood IDG Goal

- Enhance the well being and improve the quality of life for our soldiers, civilians, families, neighbors, and community through leadership in sustainable development and design;
- Meet current and future mission requirements by sustaining land, air, and water resources;
- Provide clear and comprehensive design standards and criteria for all maintenance, renovation, and new construction projects in a user-friendly format;
- Strengthen Fort Hood operational capacity by reducing our environmental footprint and minimize total ownership costs of Fort Hood systems, materials, facilities, and operations through more sustainable development and design practices;
- Use innovative technology and the principles of sustainable development and design to meet user needs and anticipate future Army challenges; and

- Develop programs and practices to reduce the consumption of energy, materials, water, and land and to support and enhance the Fort Hood 25-year sustainable development and design goals.

3.1.2 Fort Hood Installation Design Guide Objectives

- Document the visual character, assets and liabilities, and existing conditions of the installation;
- Develop recommendations, improvement projects, and sustainable development and design initiatives that will result in an improvement of the liabilities and overall visual character at Fort Hood;
- Establish specific design standards and criteria that define building placement, color, materials, and architectural style;
- Dictate specific requirements relating to site elements, force protection, landscaping, and circulation;
- Integrate sustainable development and design concepts into all standards and criteria;
- Develop processes and procedures that provide clear guidance relating to the implementation, use, and enforcement of the Fort Hood IDG; and
- Prepare an interactive web/data-based IDG to facilitate its use, compliance with requirements, and continual updating.

3.2 IDENTIFICATION AND CLASSIFICATION OF VISUAL ELEMENTS

Visual elements (e.g., buildings and structures) are the pieces that compose the visual surrounding of Fort Hood. The basic design principles (e.g., scale, color) used on the installation define the visual elements and create the feel and character of the surroundings. To understand the character of Fort Hood, one must understand design principles and visual elements. The following key design principles and visual elements provide the basic framework from which individual visual zones (Section 5) were identified for Fort Hood.

3.3 DESIGN PRINCIPLES

The visual inventory and analysis process associated with Section 5 requires an understanding of the following basic design principles.

- **Scale.** The proportional relationship of humans to their spatial environment. The scale should result in a comfortable relationship for the user and will vary as space, size, and activities vary. Human-scaled architecture is typically no higher than four to five stories and there is interest provided in reveal lines, shadows, and tactile surfaces, using indigenous materials locally available to Fort Hood.

This space functions well as an outdoor museum.

- **Form.** The size and shape of mass. Individual forms should be designed to complement one another and the environment.

- **Function.** The use of a space or an area. Function is gauged by the degree to which the space works for its intended purpose.

- **Color.** All elements of the visual environment have color. The use and arrangement of colors greatly determine the visual impact of all elements.

- **Texture.** All elements of the visual environment have texture. The use and blending of textures greatly impact the visual environment. Fort Hood has locally available indigenous materials to enhance the texture and visual character of its buildings.

Uncomplimentary color and texture can severely degrade the visual quality of an area.

- **Unity.** All elements of the visual environment should blend to complement one another. Repetition of scale, form, color, and texture results in a unified visual impression.

- **Framing.** All views include a ground plane, side planes, and overhead plane. The relationship of planes changes as the individual moves through the environment.

- **Axis.** An axis is a linear progression of space connecting two or more dominant features.
- **Terminus.** A terminus is the end of an axis and is typically defined by a dominant feature such as a building.
- **Balance.** Visual elements are composed to be symmetrical or asymmetrical. In either case, visual elements should be sized and located to provide visual balance.
- **Sustainability.** Practicing the principles of sustainable design in the planning, design, construction, and operation of infrastructure and facilities is a smart business practice.

Visual balance is achieved with the uniform planting of street trees.

3.4 VISUAL ELEMENTS

The visual elements described below include manmade and natural features and their inter-relationship. These visual elements were used to help determine visual zones for Fort Hood.

- **Natural Characteristics.** Regional and site characteristics that have been preserved and enhanced as a part of the installation.
- **Edges and Boundaries.** Linear elements such as walls, fences, or trees create separation of use and activities.
- **Buildings and Structures.** Typically the most dominant features of an installation. Their location and design characteristics determine the primary visual image.
- **Activity Nodes.** Centers of activity that attract people on a daily basis.
- **Landmarks.** Visually or historically prominent features such as towers, statues, static displays, or buildings that provide identity and orientation of place.
- **Entrances and Gates.** Provide the first and last impression of the installation.
- **Circulation System.** Includes streets, railroad tracks, trails, sidewalks, parking lots, driveways, delivery areas, and bicycle paths. The circulation system utilizes a large amount of space and creates significant visual impact.

The churches at Fort Hood are some of the more visually appealing landmarks. Most have prominent steeples, landscaping with mature shade trees, and added architectural features.

- **Trees and Other Vegetation.** Trees and other vegetation frame views and provide visual screens, shade, color, and interest in the installation.

- **Street Trees.** Street trees soften, complement, and define the road hierarchy and improve the overall visual quality of the installation.

- **Views and Vistas.** Scenic and attractive views and vistas should be enhanced. Screen unattractive views.

The 4th ID Memorial is a Fort Hood landmark

Surface parking lots, void of water retention areas and landscaping, degrade the environment and visual character at Fort Hood.

- **Open Spaces.** Open space areas create visual impact and can be designed to either separate or integrate adjacent uses.

- **Signage.** A coordinated installation signage plan addressing both exterior and interior signage facilitates circulation and provides useful information.

- **Utility Corridors.** Use utility corridors and minimize unsightly aboveground utilities.

- **Other Elements.** Note that visual elements other than those above may occur within an installation.

Fort Hood's natural vistas are being maintained for all to enjoy.

4.1 REGIONAL SETTING

Fort Hood comprises approximately 217,337 acres in central Texas in portions of Bell and Coryell Counties. The installation is located approximately 60 miles north of the City of Austin and 50 miles southwest of the City of Waco (Figure 4-1).

The installation's northern boundary is approximately 4 miles south of Gatesville, Texas. The City of Killeen is adjacent to the southern boundary while the City of Copperas Cove is located along the southwest boundary. State Highway 36 parallels the eastern boundary of Fort Hood and the main entrance to the installation is located on U.S. Highway 190, which runs along and through the southern portion of the installation. Interstate 35 is located approximately 10 miles east of the installation.

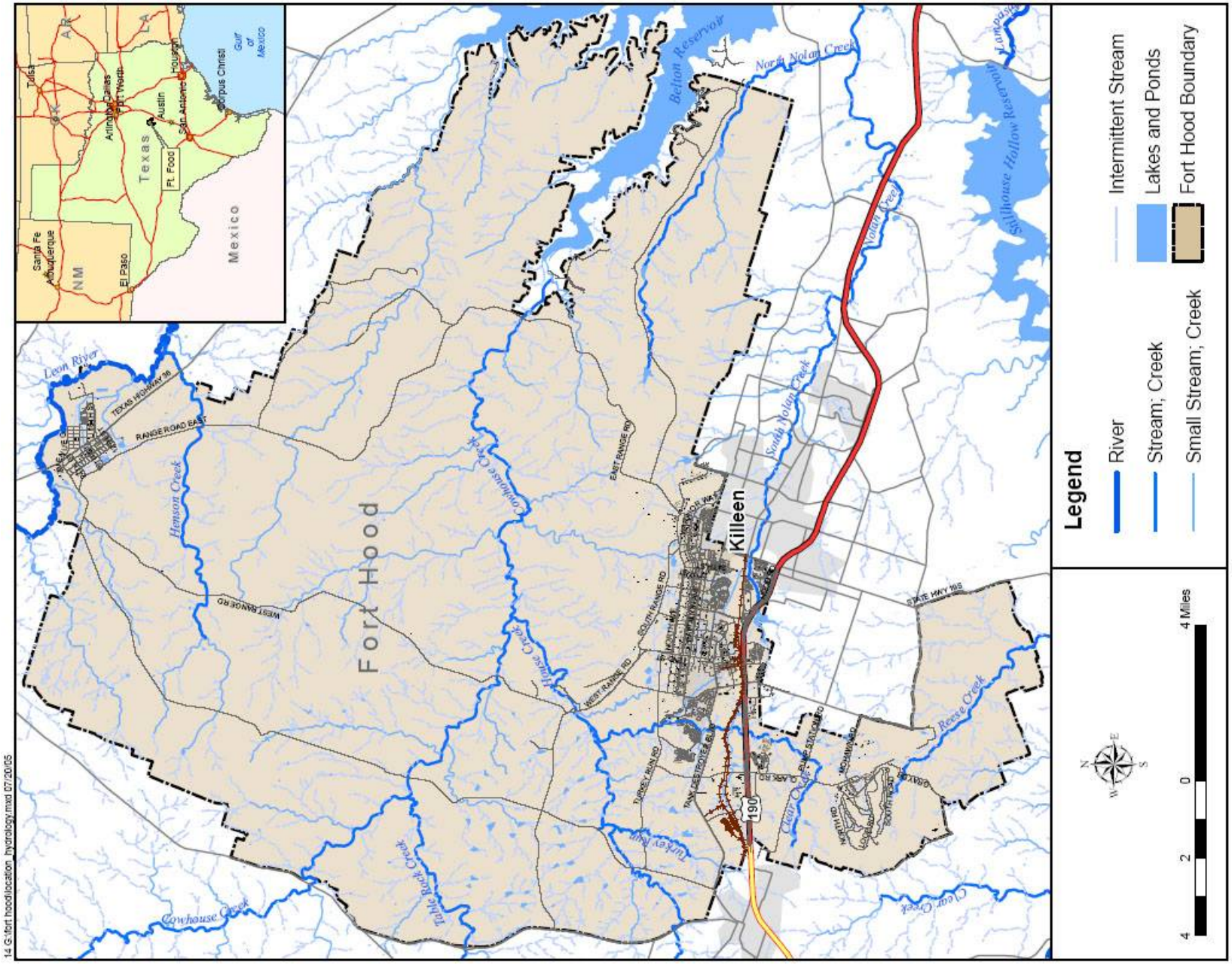


Figure 4-1 Location and Hydrology Map, Fort Hood, Texas

4.2 HISTORY OF THE INSTALLATION

In January 1942, Major Gerald R. Tyler was charged with establishing Camp Hood. His final approved plans detailed a camp of (initially) 80,000 acres with mobilization-type construction that could accommodate 23,475 troops, with utilities and hospital facilities built to accommodate an eventual garrison of 35,000 troops. This plan was estimated to cost $22,800,000 and be completely constructed no later than August 1942. His goals were set upon the understanding that Camp Hood had the highest priority rating within the Army.

Camp Hood plans were based on the rectangular (quadrangular) cantonment plan using primarily mobilization-type (temporary) construction of the series 800 building style; however, due to the expectation that Camp Hood would house several divisions – up to a minimum of seven – modifications had to be made. The original rectangular design essentially split an installation between the four divisions such that they did not intersect unless planned on the training ranges. The aim of having more then four divisions at Camp Hood challenged this approach because there was not enough training land to assign exclusively. Major Tyler modified the original approach keeping the same shape, but altering the activity areas. The Gulf Colorado and Santa Fe Railway tracks formed the northern and southern borders of the cantonment, which essentially was divided into four parts: a warehouse and technical services area, an area of troop housing, the station hospital, and the training center and school area. The training area was spread out to the north and northwest of the cantonment, rather than adjacent to each leg of the layout. This design also accommodated expected future needs for other types of units that might be posted at Camp Hood.

Construction of Camp Hood began on April 17, 1942, with the expectation of completion in five months. This expectation was met in spite of a wetter then usual spring, as well as manpower and material shortages, and changes in construction plans to add accommodations for 15,000 more troops. This success is impressive, not only because of the short timeline and complications faced to complete the project, but also because Camp Hood was the largest cantonment constructed in the United Sates. As time has shown, the construction effort is even more impressive in that the construction lasted much longer then its temporary 15-year expected life span.

North Fort Hood's construction is just as impressive, though the facilities were built at Theater of Operations standards with a life expectancy of five years. Additional construction that occurred either concurrent or within the following year include various support facilities, such as Prisoner of War Camps, civilian war housing, and Camp Hood Army Air Field. Official construction of Camp Hood was

considered completed as of September 3, 1943. At that time, the installation contained 160,000 acres, 35 “ideal” firing ranges, and 5,630 buildings.

World War II-era structures.

On April 15, 1950, Camp Hood became a permanent installation and was re-designated Fort Hood. During the post-World War II era, new masonry facility construction occurred at Fort Hood. Most of the facilities were constructed with flat roofs and minimal architectural features. In the 1960s and 1970s, some of the facilities, primarily the troop housing, were multiple-story construction.

From the 1950s to the 1970s, various family housing areas were constructed – employing local architectural talent – that departed from the rigid grid pattern of the main cantonment area. This new development pattern encompasses civilian residential development of curvilinear streets and common open space areas that were often constructed during this time period off the installation.

4.3 ENVIRONMENTAL SETTING

Plateaus are a common topographic feature at Fort Hood.

The environmental setting at Fort Hood is as varied and vast as its size. There are many environmentally sensitive features on Fort Hood that include, but are not limited to wetlands, karst features, riparian areas, and endangered species habitat. The following is a brief overview of the environmental characteristics found on the installation. Additional information related to the environmental setting may be obtained from the Directorate of Public Works (DPW), Environmental Division, Fort Hood, Texas.

4.3.1 Topography

Fort Hood is located within the “Hill and Lake Country” of Central Texas. Typical landforms include plateaus, ridges and isolated hills and sloping valley-sides (Figure 4-2). It is near the southeastern edge of the Mid-Continent Plains and Escarpments and is within the region known as the Lampass Cutplains. The Edwards Plateau is located west of Fort Hood. The basic landscape has been created by upward displacement and subsequent weathering and erosion of various limestone, shale, and other sedimentary rock strata.

The overall topography of the main cantonment area consists primarily of smaller hills and plateaus that give way to steeper inclines of ridges and sloping valley sides within West Fort Hood, the range areas and around Belton Lake.

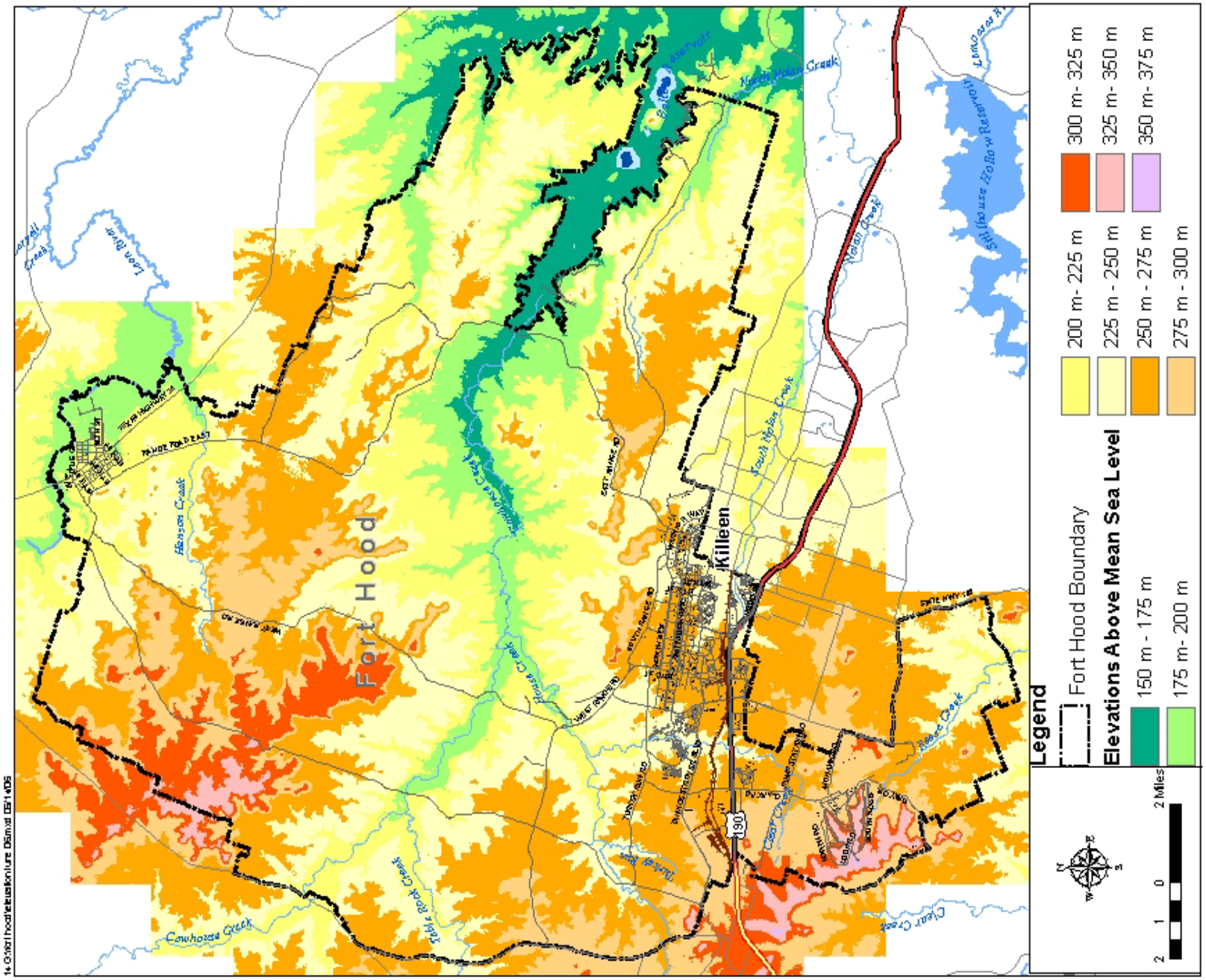


Figure 4-2 Ground Elevation Map

4.3.2 Geology

Sedimentary rocks of Cretaceous age underlie Fort Hood. Over the past 70 million years, the weathering and erosion of these rocks and the deposition of the eroded materials along major flow-ways have formed the Fort Hood landscape. Primary stratigraphic units that occur in the Fort Hood area are, in ascending order, pre-Cretaceous rocks, the Travis Peak Formation, the Glen Rose Formation, the Paluxy Formation, the Walnut Formation, the Comanche Peak Limestone Formation, and Edwards Limestone. The major flood plains are underlain by alluvium and river terrace deposits. Karst features are continually being mapped and the data are kept by the DPW, Natural Resources Management Branch (NRMB): (254) 287-2885.

4.3.3 Soils

A detailed evaluation of the suitability of a soil for a particular type of land use activity must be made for each project. Information regarding soils at Fort Hood can be found in the Soil Surveys for Bell and Coryell Counties, Texas. Copies of the soil surveys may be obtained by contacting: United States Department of Agriculture, Natural Resources Conservation Service, 101 Interstate Business, Temple, TX 76501 or (254)742-9800. Please note that soil surveys are not designed for site-specific evaluations of the suitability of soil for construction because the size of the delineation for mapping may not identify problem soils within a small area; however, published soil surveys do provide the user with an indication of the possible limitations of the soil type.

Soils at the main cantonment area, the central portion of the rangelands, and a large portion of North Fort Hood and West Fort Hood consist of the Slidell-Topsey-Brackett map unit (Figure 4-3), as described here:

- **Slidell Series.** Consists of very deep, moderately well-drained, very slowly permeable soils that formed in calcareous, clayey sediments. These nearly level to gently sloping soils are on uplands. Slopes range from 0 to 5%.

- **Topsey Series.** Consists of moderately deep, well-drained, moderately slowly permeable soils that formed in shaly and marly sediments. These soils are on gently sloping to moderately sloping erosional uplands. Surfaces are planar to concave, and slopes range from 1 to 8%.

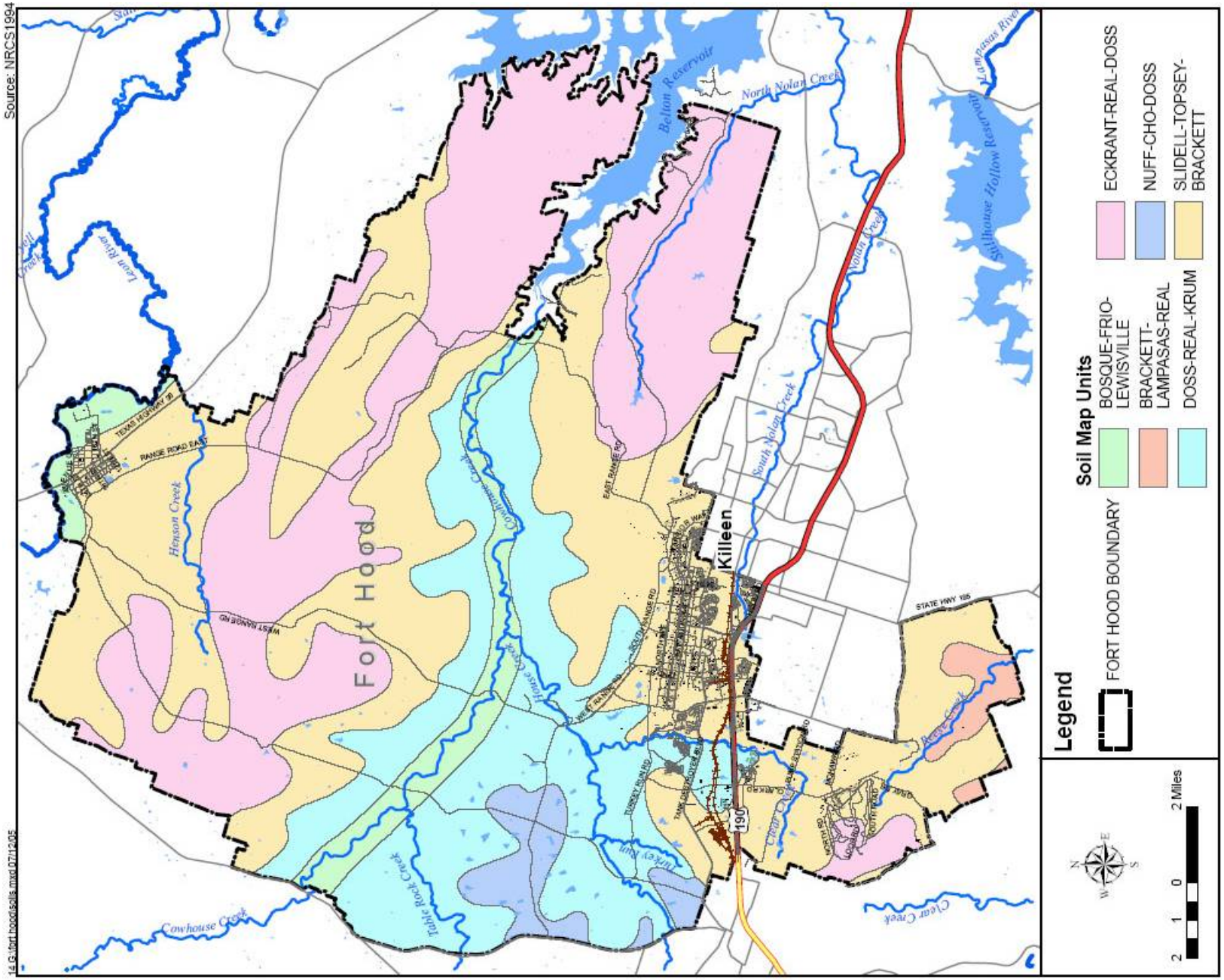


Figure 4-3 Soils (STATSGO) Map, Fort Hood, Texas

- **Brackett Series.** Consists of very shallow to shallow soils over bedrock. These well-drained and moderately permeable soils formed in residuum over chalky limestone bedrock mainly of the Glen Rose Formation. These soils are on gently sloping to very steep uplands. Slopes range from 1 to 60%.

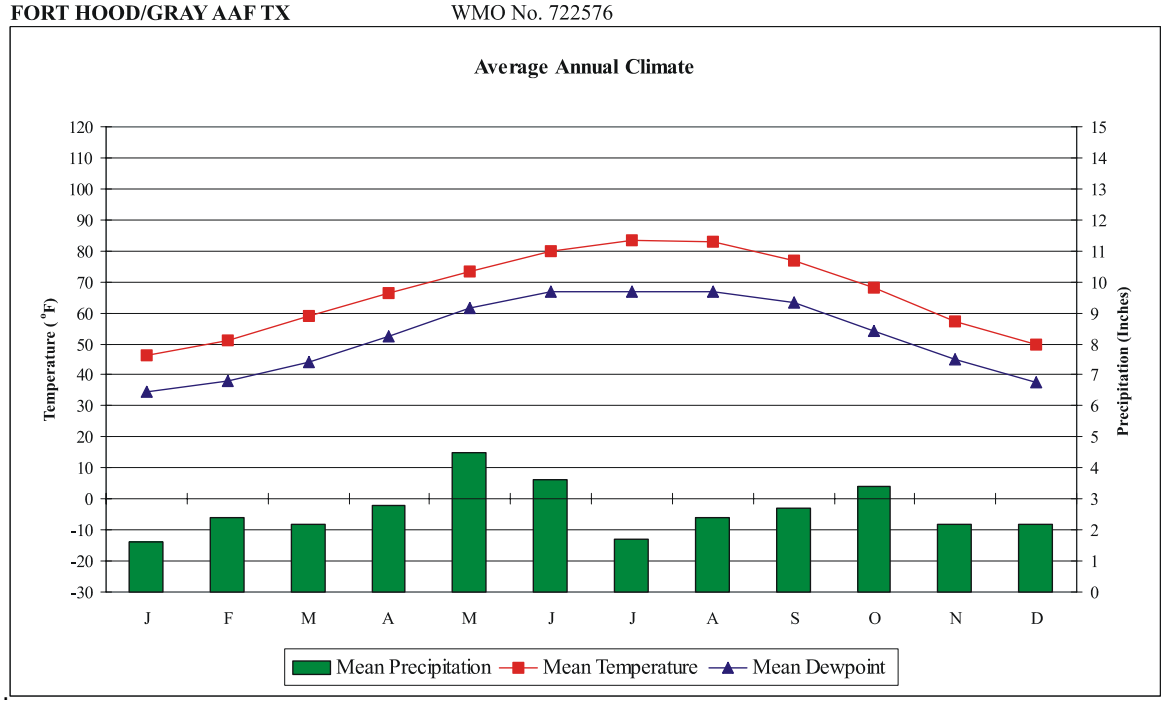


Figure 4-4 Mean Monthly Temperature and Precipitation at Fort Hood

4.3.4 Climate

Figure 4-4 presents mean monthly temperature and precipitation at Fort Hood. Mean monthly temperatures range from about 50 degrees Fahrenheit (°F) in December and January to 84°F in July and August. The average annual rainfall is approximately 31 inches. Most precipitation (more than 3 inches per month) occurs during the months of May through June and October with the least amount of rainfall occurring in January and July. Fort Hood-specific information related to cooling degree-days and heating degree-days and the frequency of different wind direction and wind combinations can be found in Appendix K: Climate.

4.3.5 Groundwater

A portion of the Trinity aquifer underlies Fort Hood and groundwater is usually encountered at depths of approximately 50 to 60 feet. Use of the aquifer by Fort Hood has ceased due to regional overuse and excessive drawdown. Belton Lake now provides the main source of potable water for the region. Bell County Water Control and Improvement District #1 and the Gatesville Regional Water Supply provide potable water to Fort Hood.

4.3.6 Surface Water

Fort Hood is located within the Brazos River Basin. Surface water runoff from Fort Hood flows generally in a southeasterly direction into the Leon River and the Lampasas River watersheds (Figure 4-1). The Leon River is fed by Nolan Creek, Cowhouse Creek, Owl Creek, and other intermittent tributaries and forms one arm of Belton Lake. Reese Creek and various other tributaries feed the Lampasas River. The Lampasas River drains into Stillhouse Hollow Lake. Approximately 200 impoundment areas and 35 springs are located at Fort Hood.

Belton Lake.

The extent of surface water resources at Fort Hood includes 692 acres of lakes and ponds, approximately 55 miles of rivers and permanent streams, and 43 miles of Belton Lake shoreline. Belton Lake is owned and operated by the USACE for flood control, water supply, and recreation.

The overarching water quality concerns at Fort Hood are sedimentation and elevated nutrient levels that are being deposited into receiving waters. Belton Lake is one such water body where substantial amounts of sedimentation can be observed.

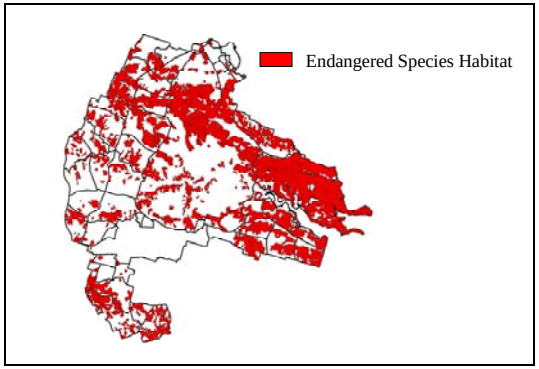
Efforts are currently underway within the rangelands to reduce sedimentation from erosion. Over the past several years, soil erosion control practices have included the revegetation of barren areas, reinforcement of stream crossings (gully plugs), and establishment of sediment control structures, diversion terraces, and hillside access trails. Soil erosion efforts also focus on better management of non-point sources. These erosion control measures are, in part, to help protect and enhance overall water quality conditions in Belton Lake and other water bodies downstream of the rangelands.

Belton Lake Sedimentation.

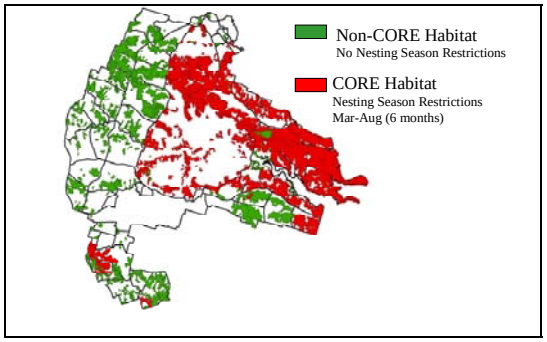
The Blackland Research and Extension Center Water Science Laboratory monitors sediment and related water quality parameters at 14 Fort Hood sites to determine the effectiveness of land management practices. These land management practices are intended to reduce elevated nutrient levels and sedimentation due to erosion. Thirteen (13) monitoring sites are instrumented with rain gauges, stream level loggers, and programmable water sampling equipment.

4.3.7 Wetlands

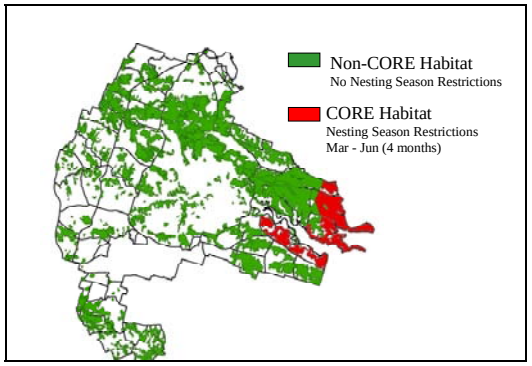
To date, there has been little delineation of wetlands on Fort Hood. Wetlands and jurisdictional waters do occur on the installation, but have yet to be identified and mapped. As these areas are identified, the data will be compiled by and available from the NRMB: (254) 287-2885.



1993 Biological Opinion, Endangered Species Habitat.



2000 Biological Opinion. Core (red) versus Non-Core (green) Endangered Species Habitat.



2005 Biological Opinion. Core (red) versus Non-Core (green) Endangered Species Habitat.

4.3.8 Vegetation

Three types of forest and shrub communities are found at Fort Hood including coniferous, deciduous, and mixed forests and shrub communities (Figure 4-5). The coniferous woodlands on the installation are dominated by Ashe juniper. Deciduous forests and shrubs are generally found in the lowlands and protected slopes and are relatively uncommon on the installation. A population of what is referred to as Fort Hood's Lost Maples can be found in the protected canyons on the installation's eastern side. Fort Hood also contains one of the rarest shrubs in North America, the Texabama croton, which is known only from three sites in Texas, two in Alabama, and one in Tennessee. Fort Hood woodlands also host large expanses of the ephemeral white dogtoothed violet, sycamore-leafed snowbells, and spicebush. The grasslands that historically have comprised much of the area are also throughout the installation.

4.3.9 Wildlife

Numerous varieties of wildlife exist at Fort Hood. These species are typical of what are generally found in Central Texas.

Within the past 12 years, three Biological Opinions (BOs) have been issued to Fort Hood after formal Section 7 consultation under the Endangered Species Act of 1973, *as amended*. The BOs specifically address habitat for the golden-cheeked warbler and the black-capped vireo (see illustrations at left) The 1993 BO was initiated regarding the impacts of military training on threatened and endangered species found on Fort Hood. In this BO, a finding of "no jeopardy" was issued by the U.S. Fish and Wildlife Service (USFWS) to the Army (USFWS 1993). Three amendments to the 1993 BO were issued and a second BO was issued in 2000. In 2005, a third BO was issued by USFWS to the Army as a result of: 1) Endangered Species Management Plan reassessment with respect to the Army mission at Fort Hood, and 2) increased military training flexibility by reducing encroachments to training created by golden-cheeked warbler and black-capped vireo habitat protection, specifically "core" habitat classification. In this BO, a finding of "no jeopardy" was issued by the USFWS to the Army (USFWS 2005).

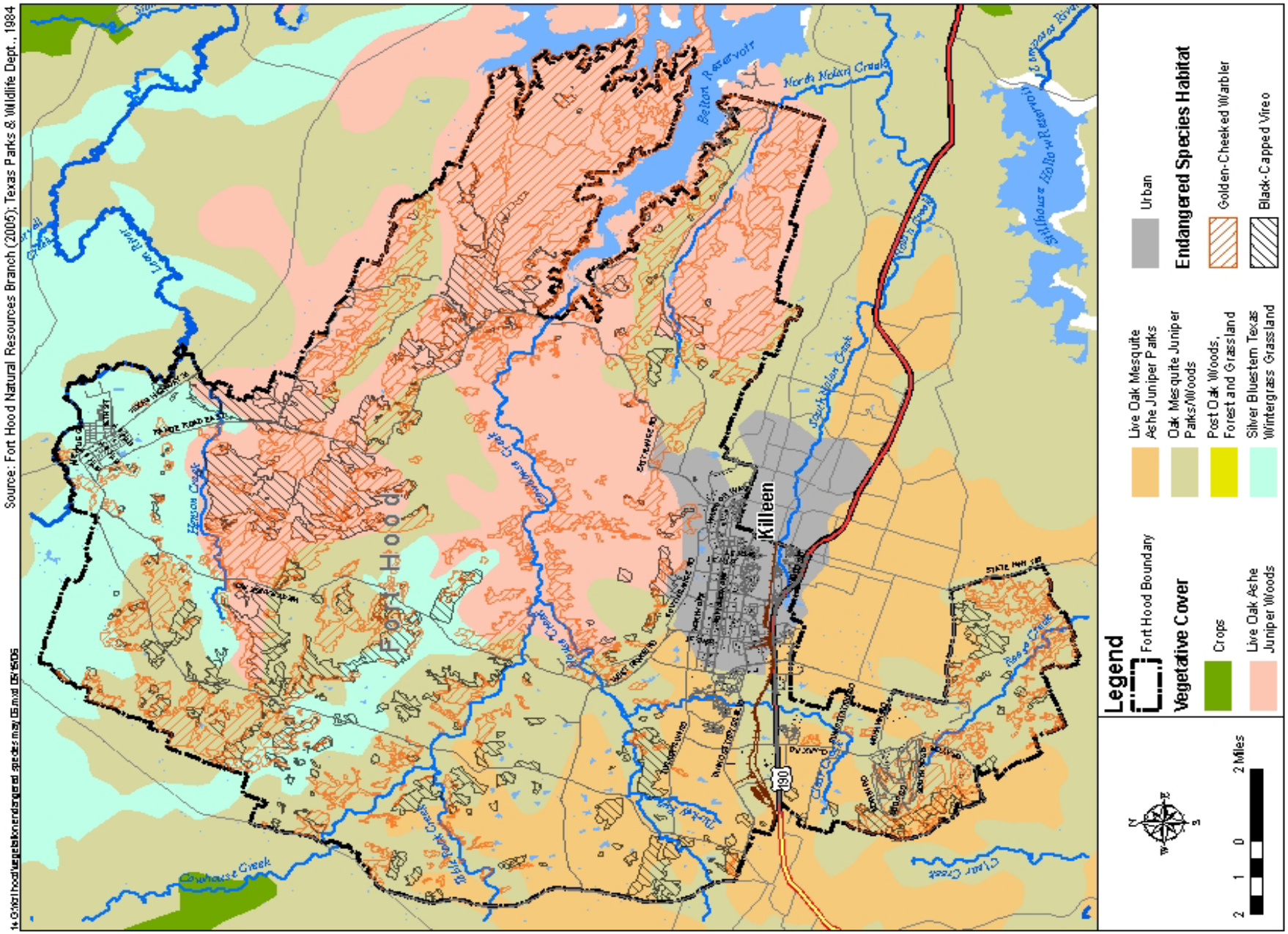


Figure 4-5 Vegetation and Endangered Species Estimated Habitat Map, Fort Hood, Texas

Within the timeframe of the BOs issued by the USFWS, total (combined) designated habitat for the golden-cheeked warbler and the black-capped vireo increased from 66,261 acres (1993) to 70,151 acres (2003; see Figure 4-5). The slight increase in habitat from 1993 to 2003 is the result of additional vireo habitat created by the 1996 wildfires, improved habitat understanding and search techniques, and the mapping of "non-traditional" habitat types for the vireos (Cimprich 2003). While total habitat has increased, there has been a significant decrease in the designation of "core" versus "non-core" habitat (see illustrations on page 4-10). Under a "core" designation, training activity in the habitat area was subject to Level 1 and Level 2 restrictions of the Fort Hood Endangered Species Training Guidelines. From 1993, when the first BO was issued, until 2000, increased training restrictions as a result of habitat included an area consisting of approximately 66,261 acres. Under the 2000 amendment to the 1993 BO; resulting in a new BO, training restrictions were reduced for areas designated as "non-core" habitat classification. As of 2005, only 9,541 acres of land (all for the golden-cheeked warbler) is designated as "core" habitat. Note: there are some training restrictions (Level 1) in all habitats whether they are designated as "core" or "non-core."

Golden-cheeked warbler.

Black-capped vireo.

4.3.10 Military Quantity Distance Arc Area

Figure 4-6 illustrates the Military Quantity Distance Arc areas at Fort Hood. These areas, enclosed within a red line, contain ammunitions and other hazardous materials. Land development activity either is not permitted or is discouraged at these locations. As indicated on Figure 4-6, most of these storage areas are located at West Fort Hood and within the rangelands.

4.3.11 Solid Waste Management

Fort Hood has developed a Solid Waste Management Plan (SWMP) and a Qualified Recycling Program (QRP). Solid waste generated from activities at Fort Hood is managed on-post. Fort Hood operates a government-owned, contractor-operated Class I municipal solid waste permitted landfill. The landfill has been receiving waste since October 1990 and services the installation only. The landfill accepts municipal-type solid waste and construction and demolition (C&D) waste that cannot be diverted. With total facility acreage of approximately 154 acres, and a design capacity of 4,042,949 cubic yards, the landfill accepts approximately 25,000 tons of municipal type waste per year (70 tons per day) plus 3,100 tons construction and C&D annually. Current life expectancy of the landfill is calculated to be approximately 67 years. Special wastes such as regulated and non-regulated asbestos-containing material and lead-based paint are accepted with a manifest from the DPW

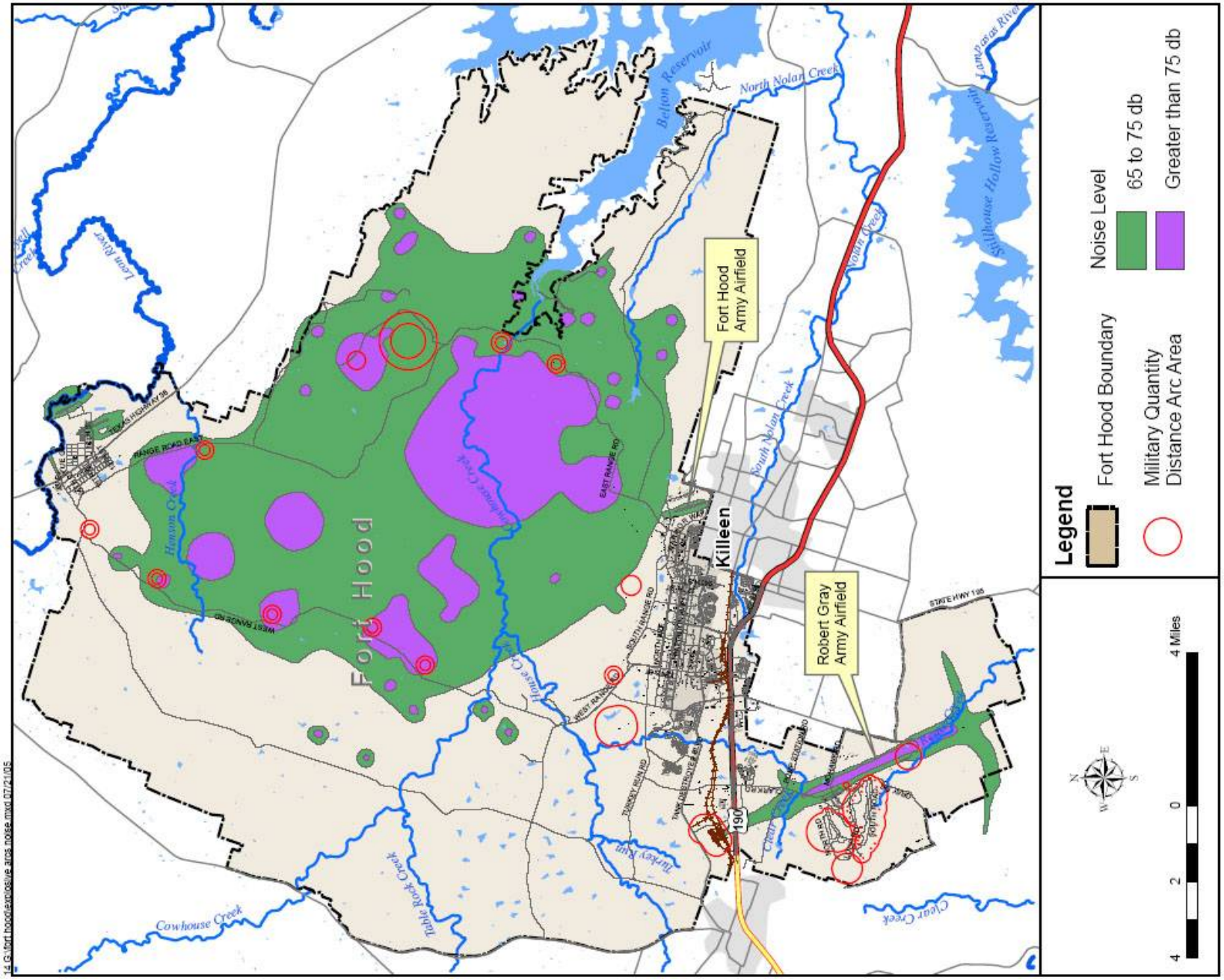


Figure 4-6 Military Quantity Distance Arc Areas and Noise Levels Map, Fort Hood, Texas

Classification Unit. Special wastes are deposited into a special trench designated to receive such wastes as long as they meet the conditions stated in the landfill's "Waste Acceptance Plan."

4.3.12 Noise

The DNL, which is a noise descriptor, is the time-weighted energy average sound level with a 10 decibel (dB) penalty added to the nighttime levels (2200 to 0700 hours). The annual average is used for all activities.

As part of the Installation Compatible Use Zone (ICUZ) program, Fort Hood has mapped ICUZ noise zones resulting from (1) transportation sources, such aircraft assessed using the A-weighted day-night average sound level noise metric (DNL); (2) noise from artillery activities (impulse noise) assessed in terms of the C-weighted DNL (CDNL); (3) and noise from small arms ranges assessed using the peak unweighted sound level. The Fort Hood ICUZ program uses the guidelines established by the Federal Interagency Committee on Urban Noise (FICUN 1980) for areas on and/or near noise-producing activities such as highways, airports, and firing ranges. The ICUZ noise zones are defined as follows (also see Table 4-1):

- **Zone I.** This zone area is considered to have moderate to minimal noise exposure and is acceptable for noise-sensitive land uses.
- **Zone II.** This is an area considered to have significant noise exposure and is normally unacceptable for noise-sensitive land uses.
- **Zone III.** This is an area where the sound level is greater and is considered to be an area of severe noise exposure and is unacceptable for noise-sensitive land uses.

As would be expected, the rangelands contain the largest extent of Zones II and III due to training-related exercises (Figure 4-6). Within the main cantonment area, aircraft operations at the Hood Army Airfield produce the most intense noise levels. However, noise Zones II and III remain within the boundary of the airfield; therefore, the activities of the airfield do not result in adjacent area land use restrictions. As expected, the other airfields located in North Fort Hood and West Fort Hood also have elevated noise levels (Zones II and III). All other areas, including the main cantonment area, have noise levels typical of an urban and suburban environment (Zone I). Noise-sensitive land uses such as housing, schools, and medical facilities are compatible with the noise environment in Zone I, normally incompatible in Zone II, and incompatible in Zone III.

Table 4-1 Noise Zone Definitions			
Criteria	**I**	**II**	**III**
Percent of Population Highly Annoyed	<15%	15% - 39%	>39%
A-Weighted Average Noise Levels (Continuous Noise)	< 65 dBA	65 - 75 dBA	> 75 dBA
C-Weighted Average Noise Levels (Impulsive Noise)	< 62 dBC	62 - 70 dBC	> 70 dBC
dBP – peak unweighted sound	< 87 dBP	87 – 104 dBP	> 104 dBP

Key:
< = less than.
> = greater than.
dBA = decibels (A-weighted).
dBC = decibels (C-weighted).
dBP = decibels (peak).
Source: Army Regulation 200-1, Environmental Quality

4.3.13 Air Quality

Fort Hood lies within the central portion of the U.S. Environmental Protection Agency (EPA) Air Quality Control Region (AQCR) #212, also known as the Austin-Waco Intrastate AQCR. The Texas Commission on Environmental Quality (TCEQ) performs air quality control functions for the region. The TCEQ has adopted the National Ambient Air Quality Standards (NAAQS) for the following criteria pollutants: ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, inhalable particulate matter, and lead.

As of April 14, 2004, Bell and Coryell Counties, including all of Fort Hood, are considered to be unclassified or *in attainment* with regard to each of the NAAQS criteria pollutants.

In 1999, Bell and Coryell Counties were two of the 95 counties in the eastern and central parts of Texas classified as “covered attainment counties.” Covered attainment counties must comply with restrictions on Reid vapor pressure, transport tanker testing, and stage I vapor recovery. Texas developed the fuel requirement to reduce emissions of volatile organic compounds as part of the State's strategy to achieve the NAAQS for ozone in Texas’s nonattainment areas. As such, these counties are now subject to portions of 30 Texas Administrative Code (TAC), Chapter 115, subchapter C that previously did not apply.

4.3.14 Archaeological Resources

Fort Hood’s Cultural Resource Management Program has overseen compliance with the National Historic Preservation Act for 2,231 archaeological sites, two Traditional Cultural Properties, historic landscapes, and historic structures since 1978. Archaeological resources are scattered about the 349 square miles of the installation, but are concentrated in the training Maneuver Areas outside the cantonment. An active evaluation program has been in full swing in recent years resulting in a reduction of the number of protected archaeological sites. As

of January 2006, fewer than 500 are protected in accordance with National Register of Historic Places criteria. Archaeological sites within the cantonment areas, Main, North Fort Hood and West Fort Hood must be taken into account when construction or other land use changes are being considered. There are also buildings, structures, and landscapes that must be considered when proposing rehabilitation, demolition, and new construction (see Section 8.8).

4.4 EXISTING LAND USE

Fort Hood is widespread and compares to any mid-sized American city in terms of its overall spatial extent and population density. The existing street network and utility infrastructure is extensive and has played a major role in shaping Fort Hood's overall visual character and way of life. Similar to other land development at Fort Hood, the primary focus regarding the design of infrastructure has been on function and less on visual qualities. The main transportation corridors from U.S. Highway 190 into the main cantonment area are Clear Creek Road, Hood Road, and Fort Hood Street. Within the main cantonment area, the transportation infrastructure resembles a grid form with adjacent, aboveground utilities (Figure 4-7). The vertical infrastructure, such as buildings, and their associated uses have been located throughout the cantonment area based on a tiered approach described in the land use section. This original tiered approach and land development pattern has remained largely intact since development began in the early 1940s.

Hood Army Airfield.

4.4.1 Main Cantonment

The main cantonment area was the location of some of the initial land development activity at Fort Hood. This activity resulted in a development form that is still largely intact today with many of the same land use types. The land use types have been positioned to best support meeting the current and future mission requirements. This arrangement of land uses and the resulting improvements have created a visual impression that is documented in Section 5.

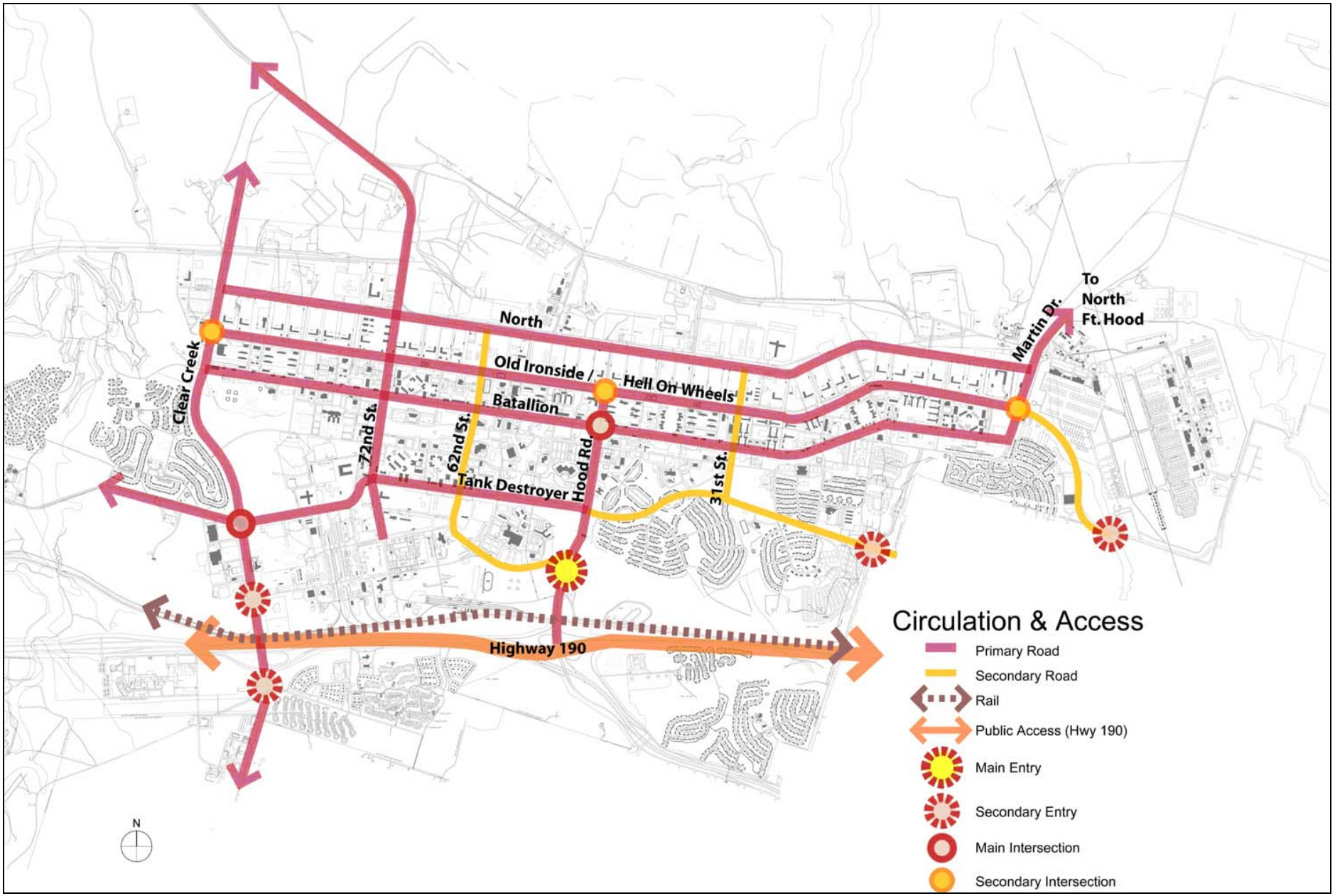


Figure 4-7 Circulation & Access, Fort Hood, Texas

The main cantonment area is established on an east-to-west linear grid where the “Troop Housing / Administration” land use is centrally located to provide soldiers direct access to the motor pool areas. The motor pool areas are located within the “Light Industrial / Maintenance” land use area immediately to the north of troop housing. A boulevard-type corridor separates these two land uses. The “Airfield” land use type is positioned at the eastern terminus of this boulevard and is also the location of Hood Army Airfield. The rangelands are located north of the motor pools and contain the “Training” land use designation. The soldiers are supported to the south of troop housing by various facilities located within the “Recreation and Community Facilities” and “Medical” land use areas.

The older “Family Housing” land use areas are primarily situated at the southern extent of the main cantonment area while the newer ones are west of Clear Creek Road. Development within this land use type has resulted in some deviation of the rigid grid pattern that is visually evident within the remaining main cantonment area.

The exact locations of existing land use designations within the main cantonment area are illustrated on Figure 4-8.

4.4.2 North Fort Hood

North Fort Hood was developed in the 1940s and has the same land use tiering and rigid grid pattern as the main cantonment area. The grid is orientated in a northwest and southeast manner with the maintenance warehouse or mission-orientated facilities located between troop housing and rangelands. Both the Longhorn and Shorthorn Auxiliary Landing Strips are located toward the eastern extent of North Fort Hood. Large, open-space areas located within North Fort Hood provide additional capacity required during reserve training (Figure 4-9). Much of the North Fort Hood area is undergoing redevelopment.

4.4.3 West Fort Hood

The Robert Gray Army Airfield is the primary land use within West Fort Hood. This area of Fort Hood has interesting geographic features that contribute to West Fort Hood’s overall sense of being isolated from the rest of the Fort. Due to extensive ammunition storage facilities in the area, its land development intensity has been kept relatively low compared to the main cantonment area. The “Troop Housing / Administration” and “Light Industrial / Maintenance” land uses are located immediately northwest of the Robert Gray Army Airfield (Figure 4-10).

4.5 PROPOSED LAND USE

Figures 4-9, 4-10, and 4-11 illustrate expected, but not yet authorized, future land use within the cantonment area, North Fort Hood, and West Fort Hood, respectively. Future efforts associated with updating the Fort Hood Real Property Master Plan may result in a change to this map.

Figure 4-8 Land Use, Fort Hood, Texas

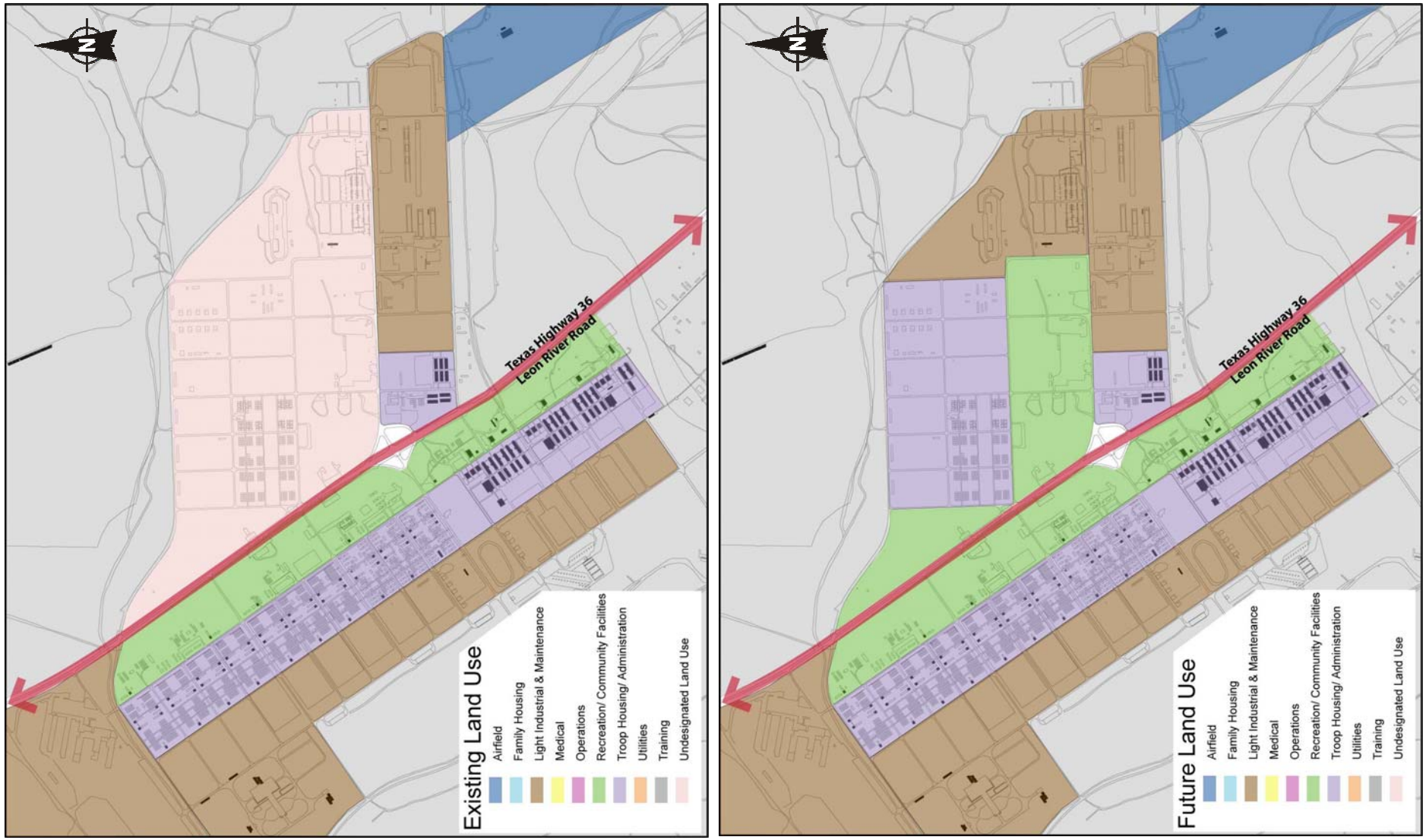
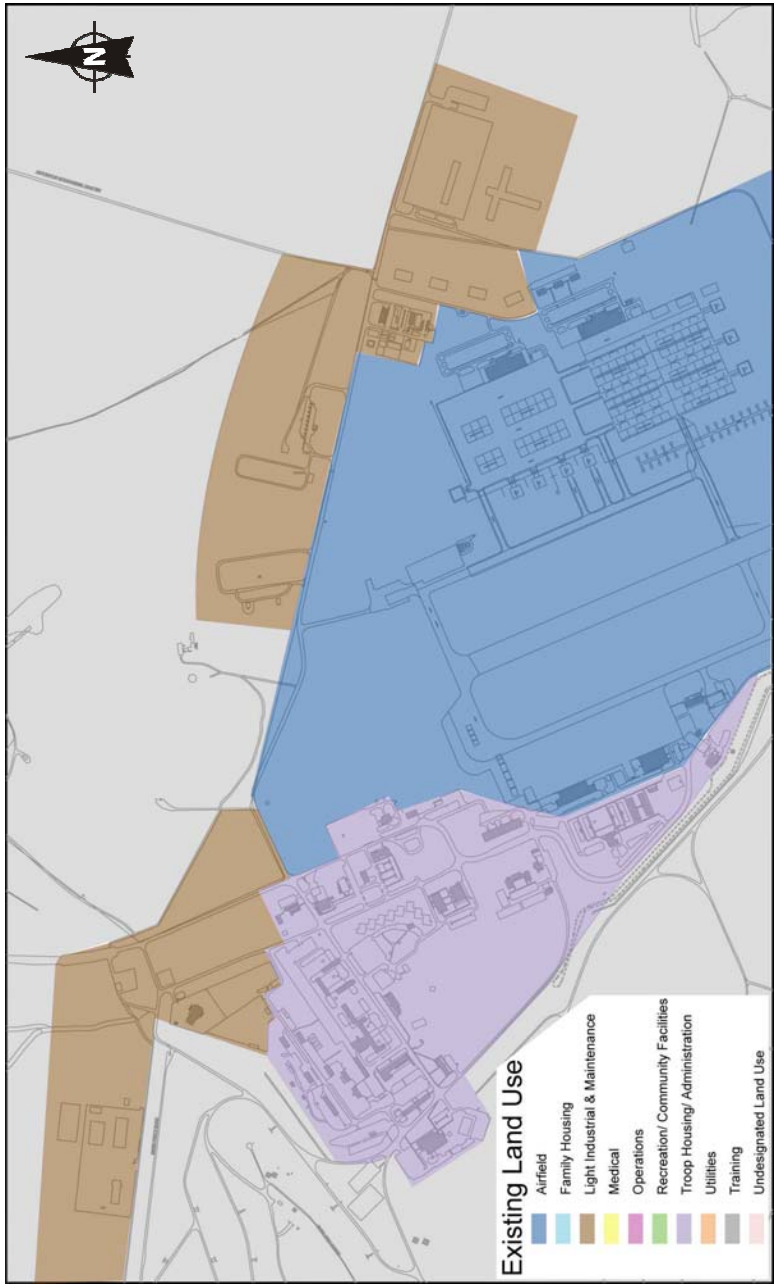


Figure 4-9 Land Use, North Fort Hood, Texas



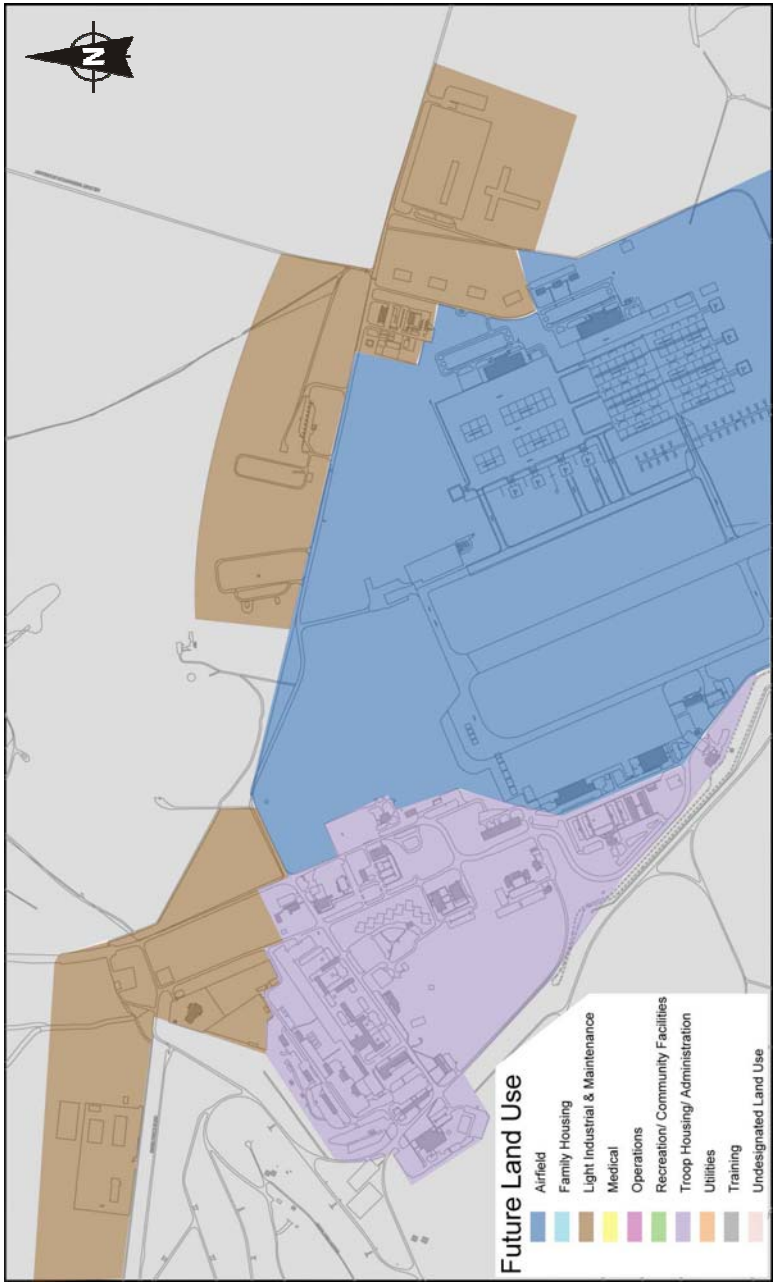


Figure 4-10 Land Use, West Fort Hood, Texas

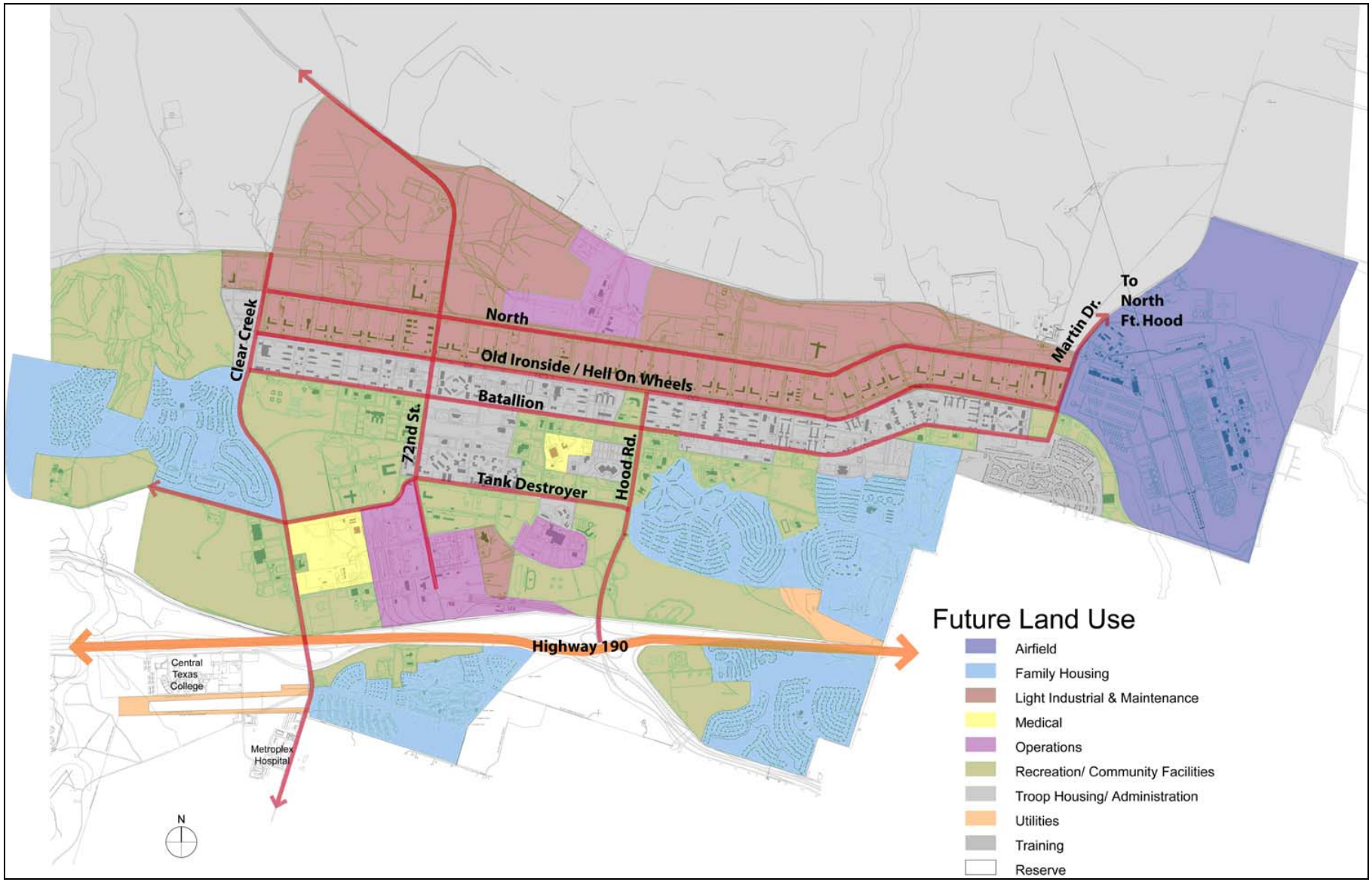


Figure 4-11 Future Land Use, Fort Hood, Texas

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- U.S. Fish and Wildlife Service, 1993, Biological Opinion, http://cswgcin.nbii.gov/ecoregion/forthood/report/Appendices/1993_biological_opinion.htm, USFWS, Austin, Texas.

5.1 INTRODUCTION

Visual themes and zones are based upon visual and spatial surveys of the installation. Visual themes are defined as the concept of "sense of place." With visual themes being broader areas of the installation that represent a similarity in use and characteristics, the definition of visual zones provides a framework to further define the visual characteristics of the installation. Visual characteristics define a look and feel of an area together with the dominant features that define its image. Typical visual characteristics include unique buildings, vehicular and pedestrian corridors, natural features and spatial relationships.

Visual themes and zones were initially based upon the previous Installation Design Guide dated 1988. Visual and spatial surveys, which were conducted during the course of three site visits, November 1 through 5 and December 6 through 10, 2004, and May 23 through 26, 2005, were used as a validation process to verify the current visual status of the installation. The surveys utilized existing installation maps, visual inspection, interviews, questionnaires, and photographs to record impressions of visual and spatial conditions. The data captured were used to further validate and define the current visual themes and zones of the installation. In the course of the surveys it was discovered that the installation is changing at a rapid pace; therefore, a new visual zone map, called a Future Visual Zone

The chapels are distinct architecture.

The troop housing is unified in its architectural character.

New family housing displays indigenous colors and materials.

Map, was developed which took into account future projects and development trends. Maps and supporting narratives for future visual zones can be found in Section 5.5. The Future Visual Zone Map takes into account the future development of Fort Hood based upon the future land use map and future projects known at the time of this study. The Future Visual Zone Map will take the place of the existing visual zone map, and all design guidelines in sections 7 through 12 will apply to the Future Visual Zone Map.

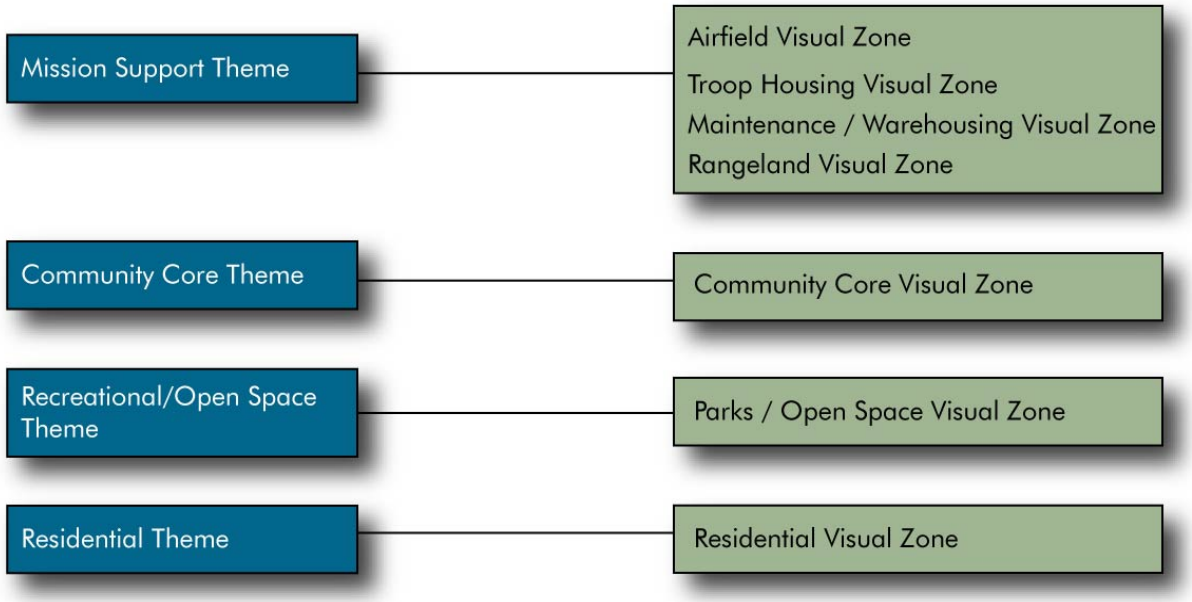
Existing architecture on Fort Hood is generally similar in nature, color and scale, which forms the basis for a design trend that should be built upon. A few select groups of older buildings in the vernacular style exist; including chapels contribute historical design character. Buildings on Fort Hood that make strong design image statements include the newer motor pool buildings in the industrial areas. Additionally, the new commercial buildings, such as the medical complexes and eating establishments, are breaking away from the traditional architectural style previously seen on Fort Hood and incorporate new colors and materials into the architecture pallet. Most of the architecture found in residential areas has a fundamentally similar quality, and recent additions exhibit a trend towards the use of better building materials which require less maintenance.

Both unity and distinctiveness are two overall visual principles that are evidenced on the installation. Fort Hood has a simple and effective plan expressed by its linear layout and organization of activities. As such, assets that contribute to this ease of orientation should be preserved and promoted as part of the theme of unity, balanced with a blend of diversity. Unity and simplicity can be over-applied and should be carefully balanced. One of the single greatest visual liabilities of Fort Hood is that unity is so well implemented in plan that its uniformity, particularly in architectural design and to some extent in landscape, could potentially become monotonous. To this end, distinctiveness should be balanced to promote a recognizable visual hierarchy in styles, forms, colors and arrangements.

5.2 FORT HOOD VISUAL THEMES AND ZONES

Visual themes are the result of generalized groupings of visual areas which generally have the same use and visual characteristics. Representing a broad scale of site activities that occur throughout the installation, these activities typically include similar functional, design and layout characteristics. Four visual themes have been identified on Fort Hood, including Mission Support, Community Core, Recreation/Open Space and Residential.

Seven visual zones have been defined under the umbrella of these visual themes and include airfield, troop housing, maintenance and warehousing, rangeland, community core (main cantonment and suburban), parks and open space, and residential. The following diagram depicts the relationship between the visual themes and the visual zones (Figures 5-1 through 5-3).



Fort Hood's architecture is the predominant defining factor of the visual zones. Landscape development, or in some cases, the lack of landscape, is also a large element of the visual zone composition. Trees appear to be randomly planted without a design theme or purpose and there is a general lack of shade trees throughout the installation.

Visual characteristics on Fort Hood are composed of elements such as walkways, parking, street furniture and other amenities. These elements enhance function, aesthetics and livability and, when implemented consistently, unify the installation as a community and reinforce the defined image of each visual zone. The largest positive impact can be seen when the visual elements are consistently applied along a major roadway, such as Battalion Avenue or Hood Road.

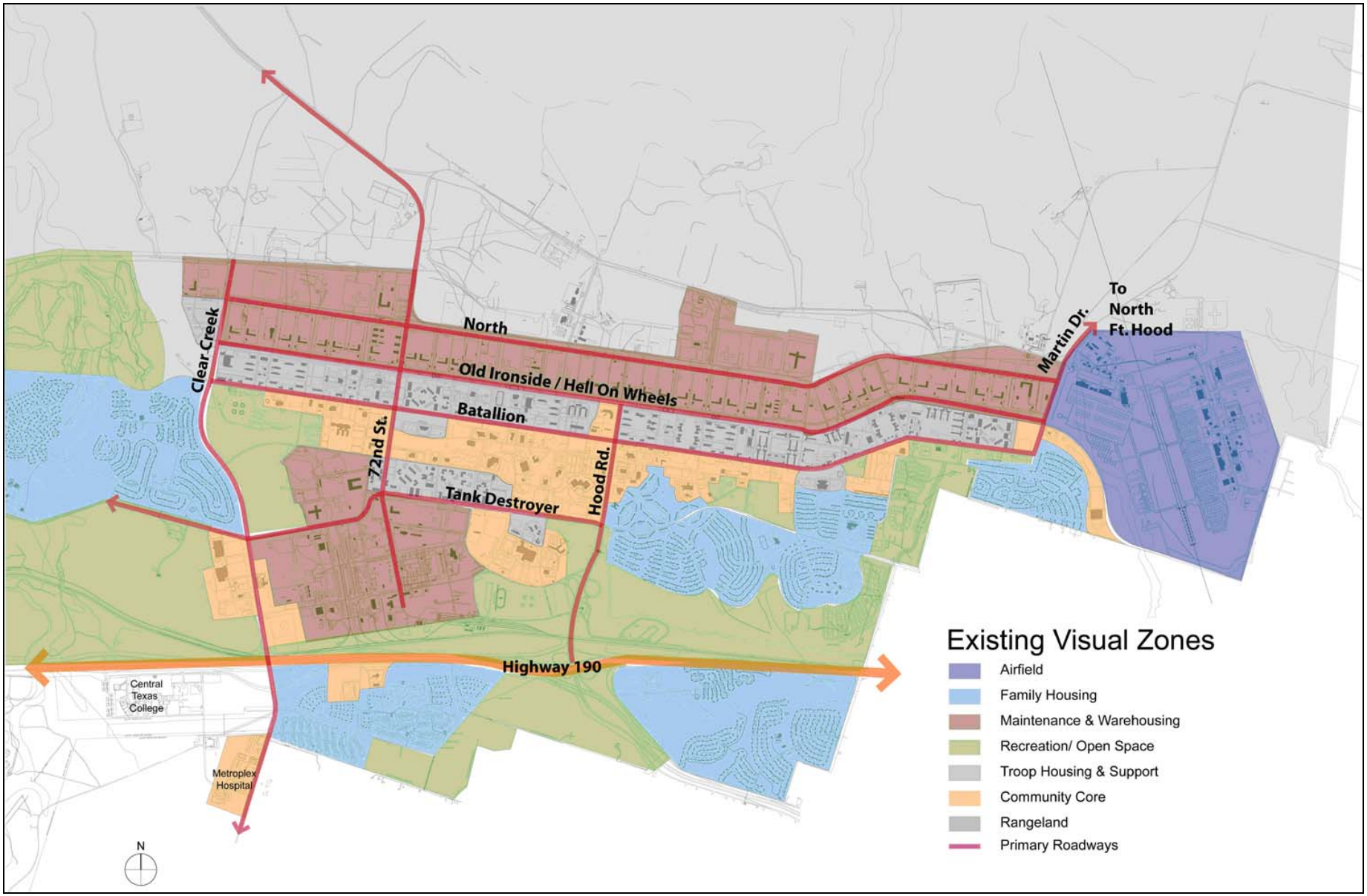


Figure 5-1 Main Cantonment Existing Visual Zone

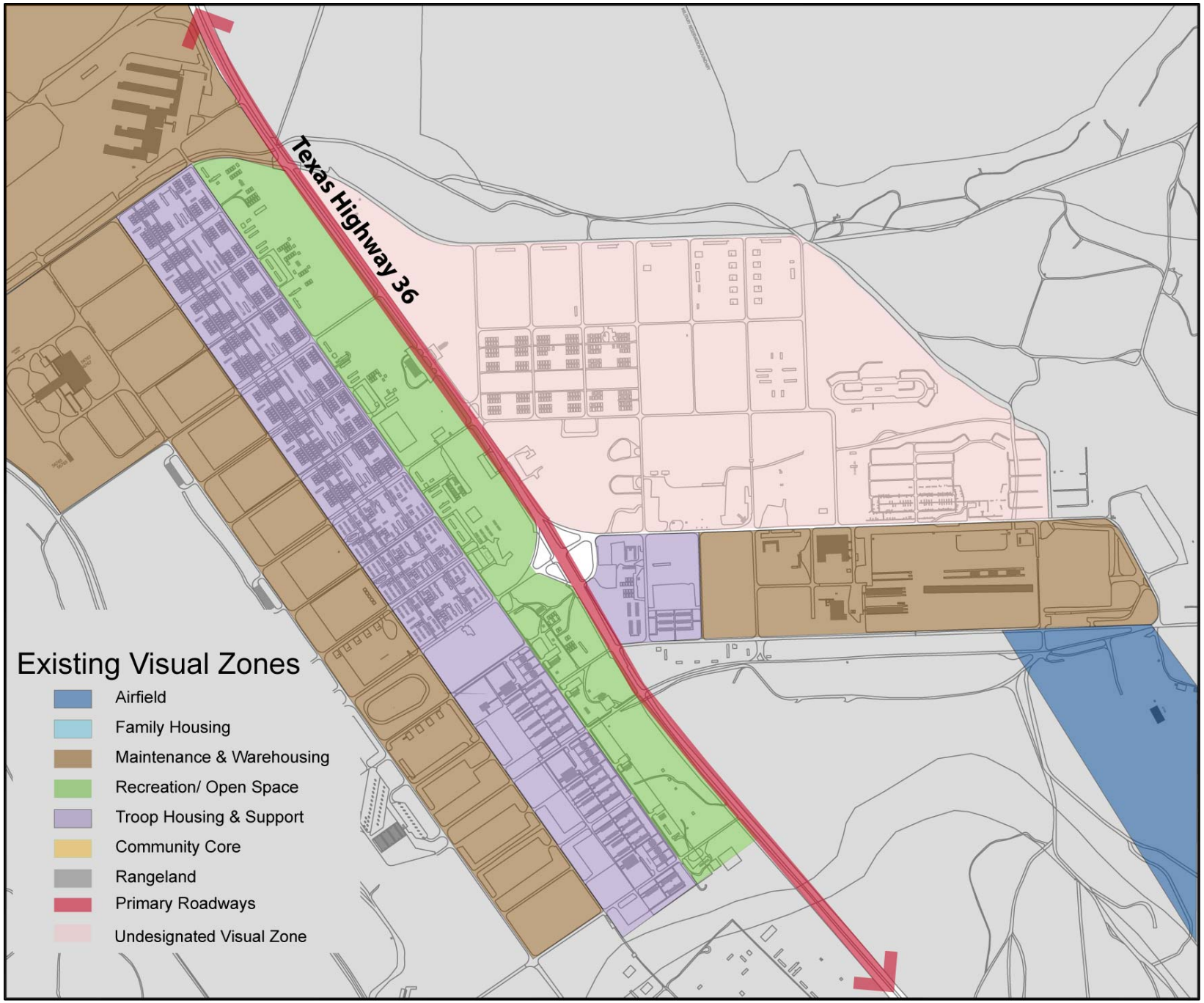


Figure 5-2 North Fort Hood Existing Visual Zone

Figure 5-3 West Fort Hood Existing Visual Zone

The following narratives present an analysis of each visual zone, which includes a description of visual character, a visual analysis map, a definition of assets and liabilities, as well as visual design and, to some extent, planning recommendations for each zone. The visual analysis maps graphically illustrate the features that contribute to the opportunities as well as the constraints that affect the visual character of the zone. Assets and liabilities have been determined in accordance with installation visual goals and objectives, design principles and visual elements, which are organized into the components of site planning, buildings, circulation, plant material, site elements, and force protection, consistent with sections 7 through 12 of this Installation Design Guide. Recommendations are included that seek to correct the liabilities, as well as to build upon and/or enhance the assets. These recommendations form the basis of the projects that are listed in Section 6, Improvement Projects.

5.2.1 Mission Support Theme

The Mission Support Theme represents the work environment that supports Fort Hood's basic missions and includes barracks, administration, operation, maintenance, training and warehousing functions. The Mission Support Theme creates an orderly image through the application of industrialized materials and methods. Structures exhibit regimented straight lines, a lack of ornamentation, large bold planes and surfaces and, in most cases, an avoidance of vernacular or historic form. Included within the Mission Support Theme are four visual zones: Airfield Visual Zone, Troop Housing Visual Zone, Maintenance and Warehousing Visual Zone, and Rangeland Visual Zone.

Administration building.

Hood Army Airfield.

5.2.1.1 Airfield Visual Zone

Two areas comprise this Visual Zone: Hood Army Airfield, which flows from the eastern portion of Fort Hood's main cantonment area, and Robert Gray Army Airfield at West Fort Hood (Figure 5-4). These two areas include the major air-focused activities on the installation and visually correspond to their functional activities. Access and views of Hood Army Airfield from Warrior Way is very impressive and creates a positive visual impact. Troop housing is located immediately adjacent and provides relatively easy access to the airfields and work activities.

The aircraft housing, maintenance and warehousing structures reflect their usage and take on an "international industrial" style, appropriate to their functions. These buildings are of large block massings in form and structure, with metal ribbed siding in vertical relief. Natural lighting is liberally used and the vehicular building access is emphasized. Landscape development is minimal in this zone where functionality is emphasized and site systems and utilities are simple and industrial in nature. Figures 5-5 and 5-6 show primary features identified for each area during the visual zone analysis.

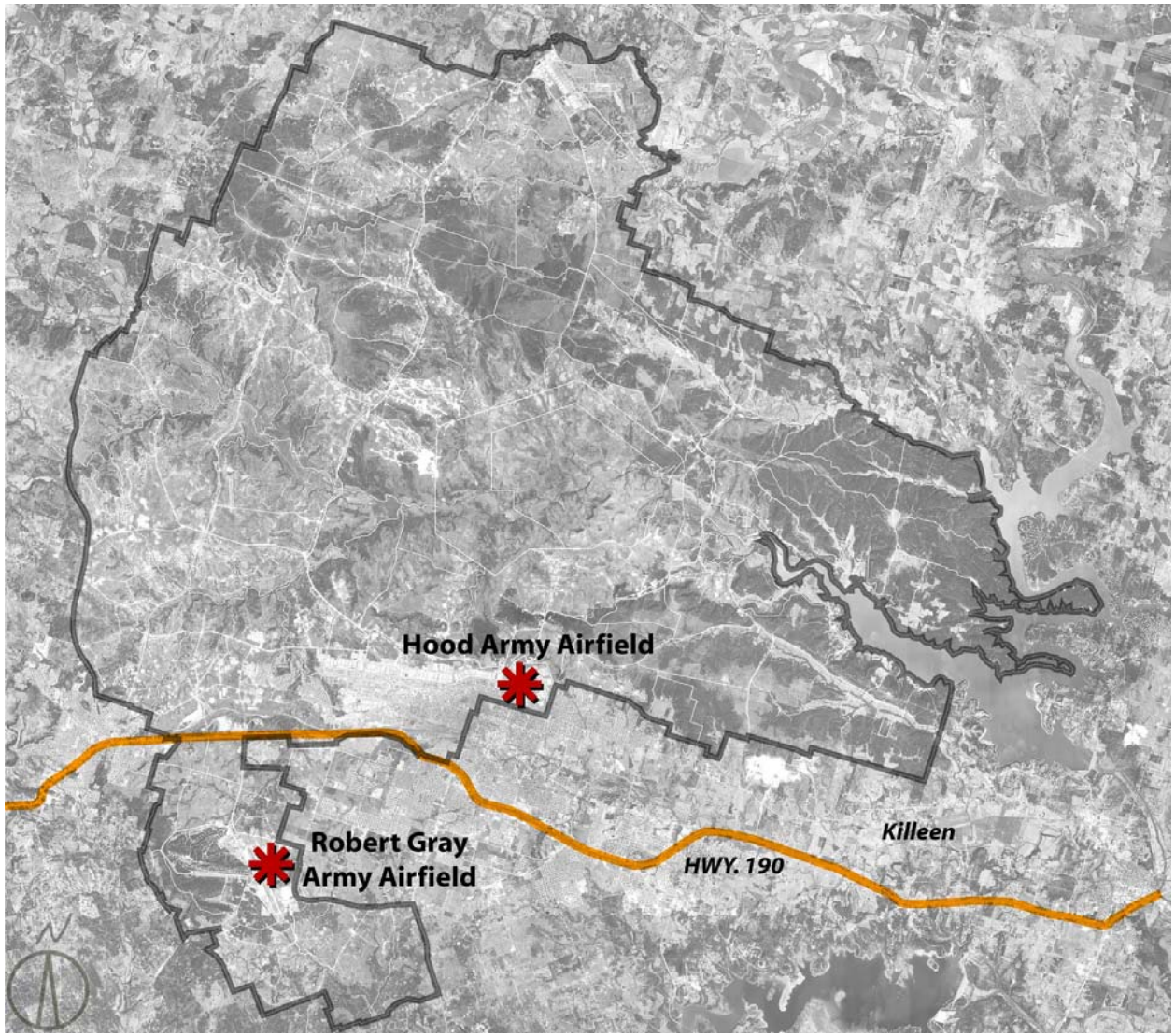


Figure 5-4 Airfield Visual Zone Location Map

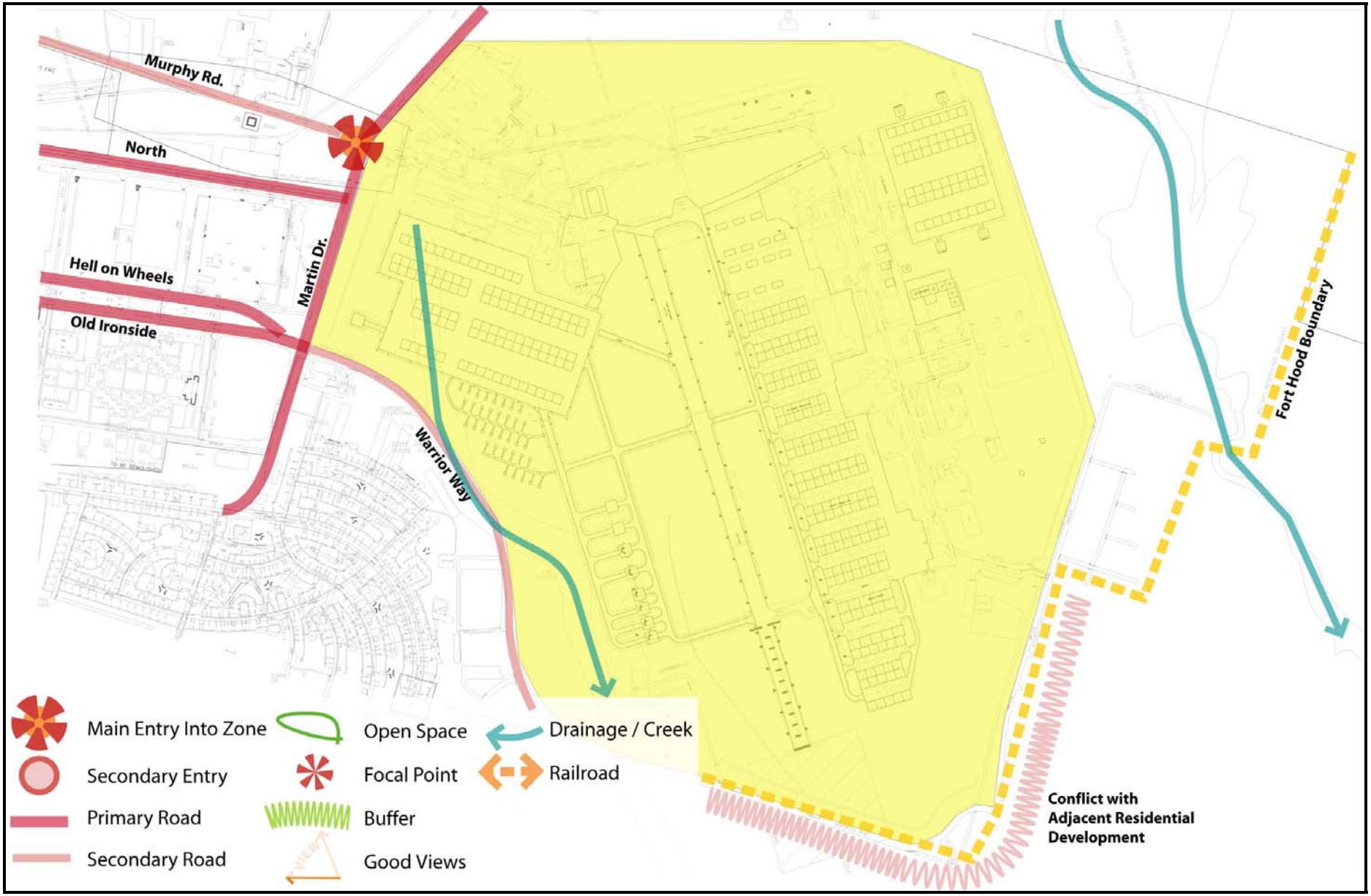


Figure 5-5 Airfield Visual Zone Site Analysis – Hood Army Airfield

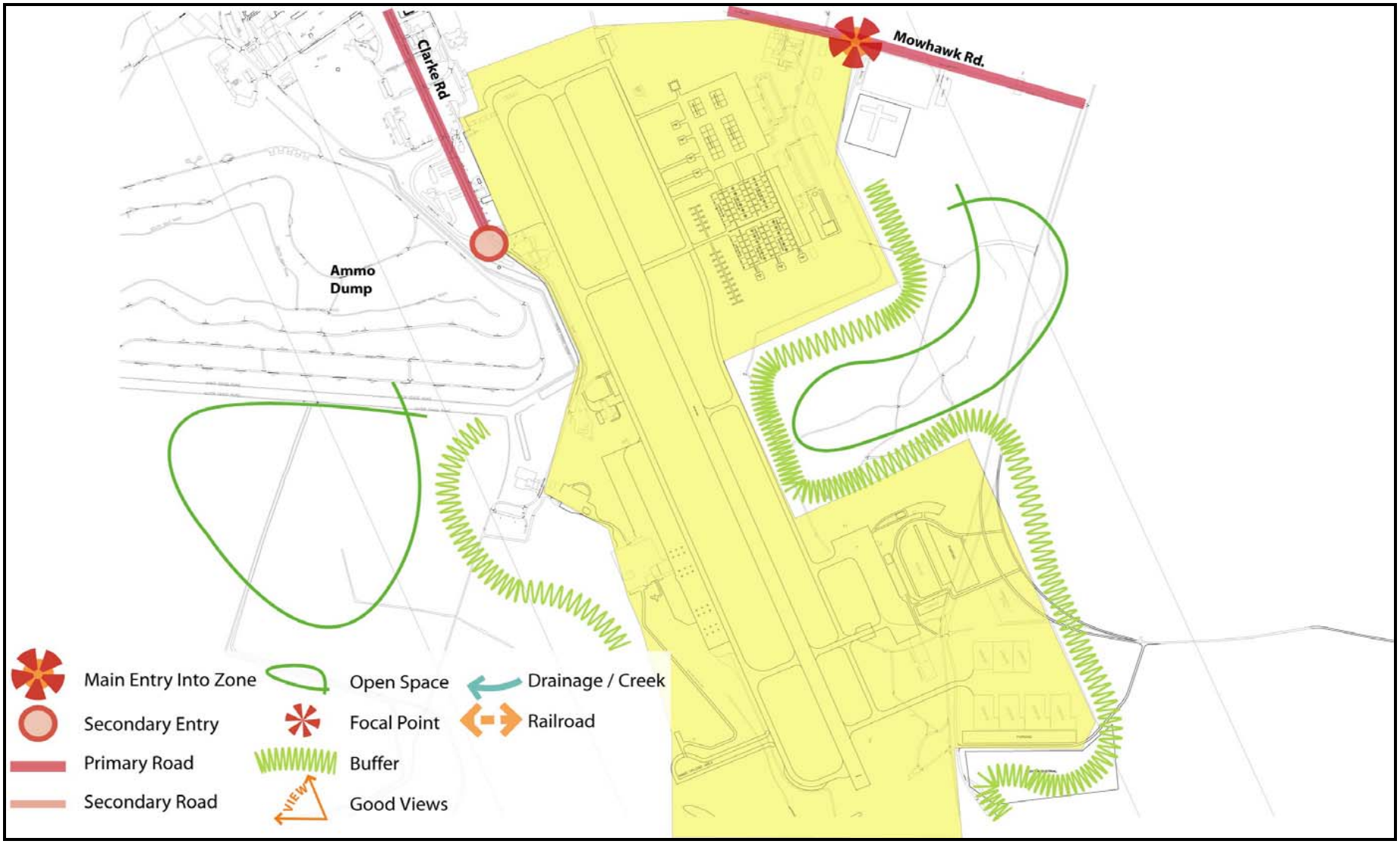


Figure 5-6 Airfield Visual Zone Site Analysis – Robert Gray Army Airfield

5.2.1.2 Troop Housing Visual Zone

The Troop Housing Visual Zone exists in the main cantonment, North Fort Hood and West Fort Hood (Figure 5-7). The zone in the main cantonment area is lineally organized following the original installation layout. Battalion and Central avenues run the east-west length of the zone and a series of streets form a fairly rigid grid plan with good circulation linkages. The relationship of the site functions within this zone forms a basic organized structure of "live-work-play." The Maintenance and Warehousing Visual Zone is to the north and the Community Core Zone is to the south. This arrangement provides the benefit of pedestrian movement from the housing and administration facilities to the support and maintenance/warehousing areas. This zone is the installation's best example of well thought-out site planning.

The 3900 Block area of the Troop Housing Visual Zone is also located in the main cantonment, but is detached from the linear area which is a part of the original layout of the installation. Bound to the north by Support Avenue and to the south by Tank Destroyer Boulevard, the Tank Destroyer Pod has an adjacency to the Main Headquarters Building. The troop housing buildings are multi-story and have neutral brick facades. The housing layout results in clusters of buildings together that form park-like common areas. These building clusters are ringed with parking and have some well-established street trees.

The North Fort Hood troop housing area has an organized grid layout of mostly temporary structures ranging from small, rectangular metal modular housing to barrack-like rectangular wood housing. This zone appears to be going through a transition period with older housing being torn down and the lots cleared. This leaves the zone with large voids of open space that are either grass or exposed dirt. Minimal landscaping exists except for a small stand of trees where some of the housing is nestled. The main point of entry into this zone is on the northwest corner. Site furnishings are minimal to none.

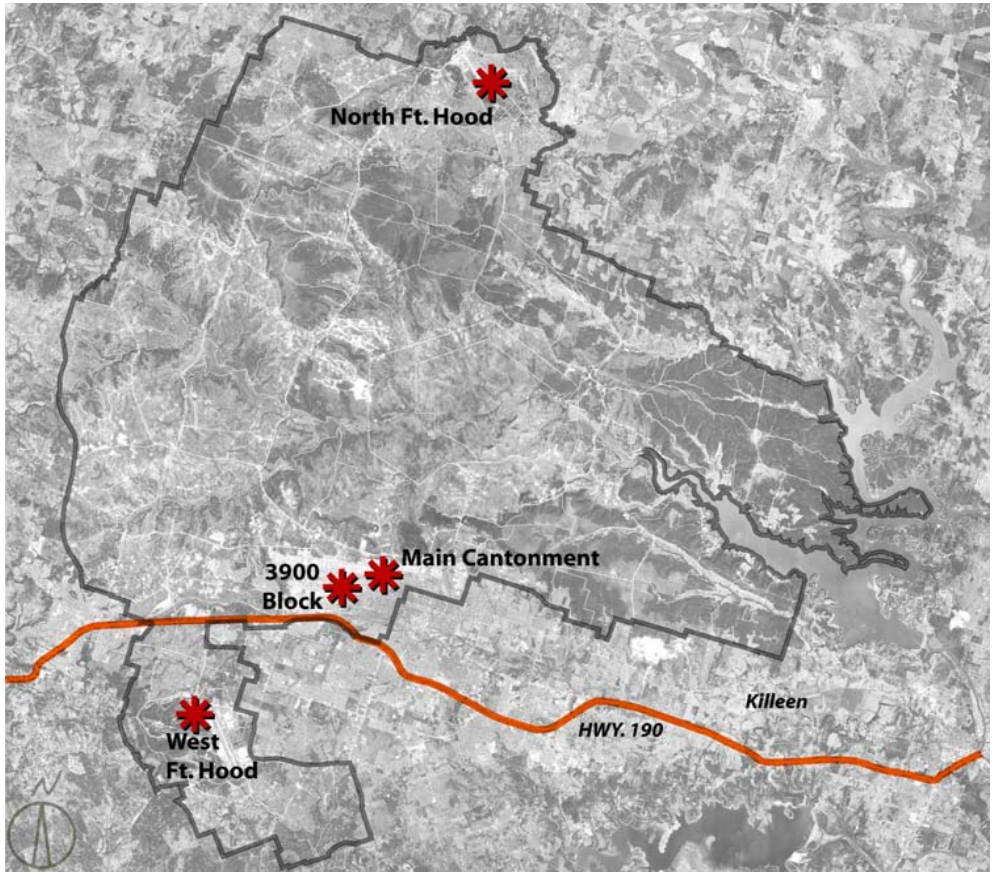


Figure 5-7 Troop Housing Visual Zone Location Map

North Fort Hood housing character.

International style dining facility.

Alternate style in main cantonment.

West Fort Hood has taken its architectural cues from the main cantonment troop housing. The building style, color pallet, relationship to the road, and relationship with other housing buildings is very similar, if not identical, to that in the main cantonment area. However, minimal landscaping and the lack of surrounding character cause the troop housing area in West Fort Hood to fall short of its model in the main cantonment.

In general, the design vocabulary of the Troop Housing area is international style with expressed structure and shade/shadow lines of walkways and balconies. The forms are characterized by flat roofs and simple rectangular shapes two to four stories in height. Earlier housing blocks were lower, single story structures and have been in-filled over time with denser, taller housing blocks that consume less land and provide greater efficiency. This newer development is preferable and very desirable for long-term growth and sustainability. The efficient organization of structures contributes to a strong visual image of troop housing areas in the cantonment zone. The adjacent positioning of the administrative functions facilitates immediate access and convenience. Many of the housing units have well developed landscaping and recreational support courtyard spaces. These developments are more urban in nature and exhibit many of the basic planning elements that enhance the quality of livability on Fort Hood. Figures 5-8 through 5-10 show primary features identified for each area during the visual zone analysis.

New troop housing architectural style in the main cantonment.

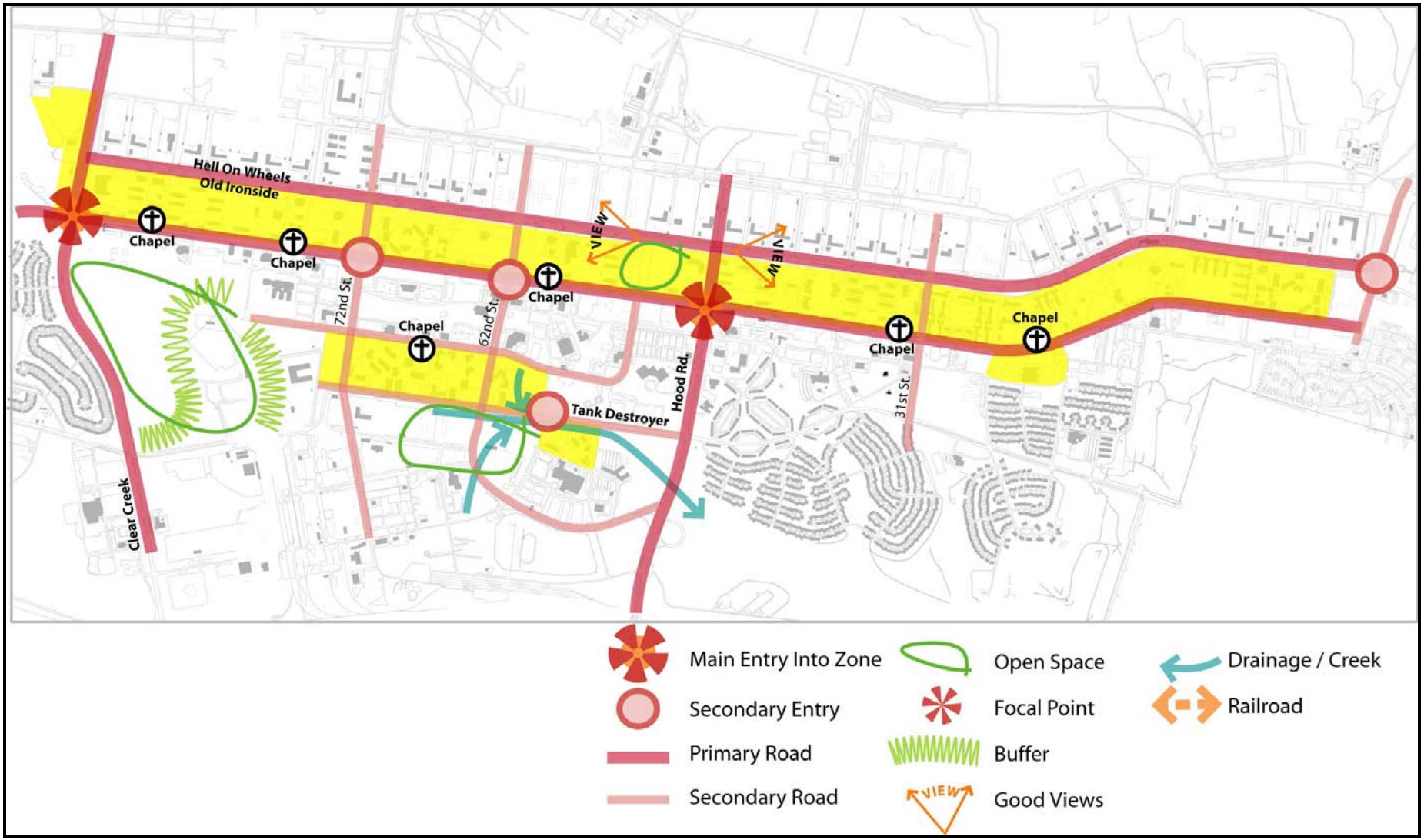


Figure 5-8 Troop Housing Visual Zone Analysis Map– Main Cantonment

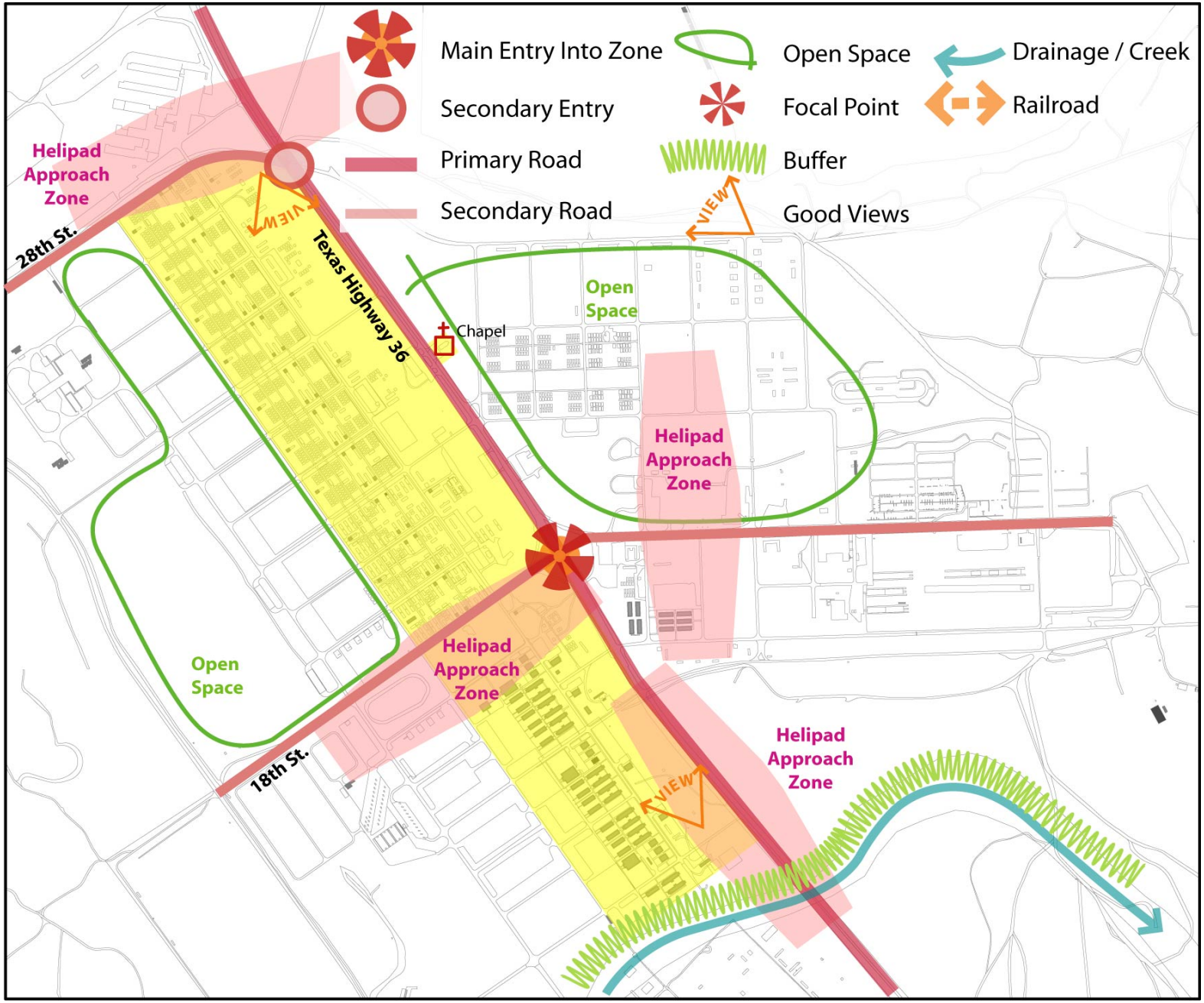


Figure 5-9 Troop Housing – North Fort Hood Analysis Map

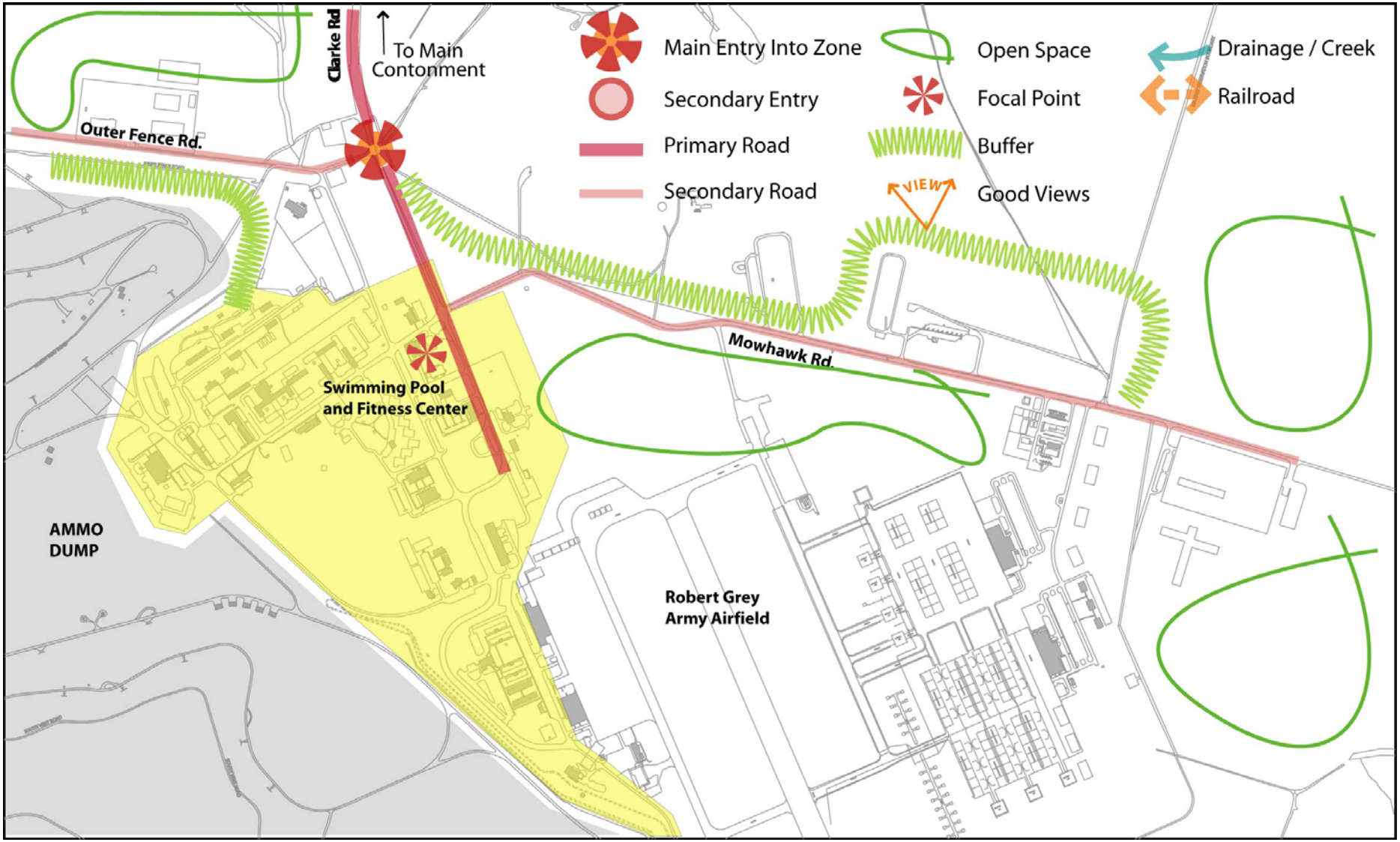


Figure 5-10 Troop Housing Visual Zone Analysis Map – West Fort Hood

5.2.1.3 Maintenance and Warehousing Visual Zone

The Maintenance and Warehousing Visual Zone includes five sub areas (Figure 5-11). Three sub areas are located in the main cantonment area and include: Maintenance Row, between North Avenue and Hell on Wheels Avenue; the Directorate of Public Works (DPW) industrial area; and the POL (Industrial) area just north of U.S. Highway 190. Maintenance and Warehousing Visual Zone sub areas are also located at North Fort Hood and West Fort Hood.

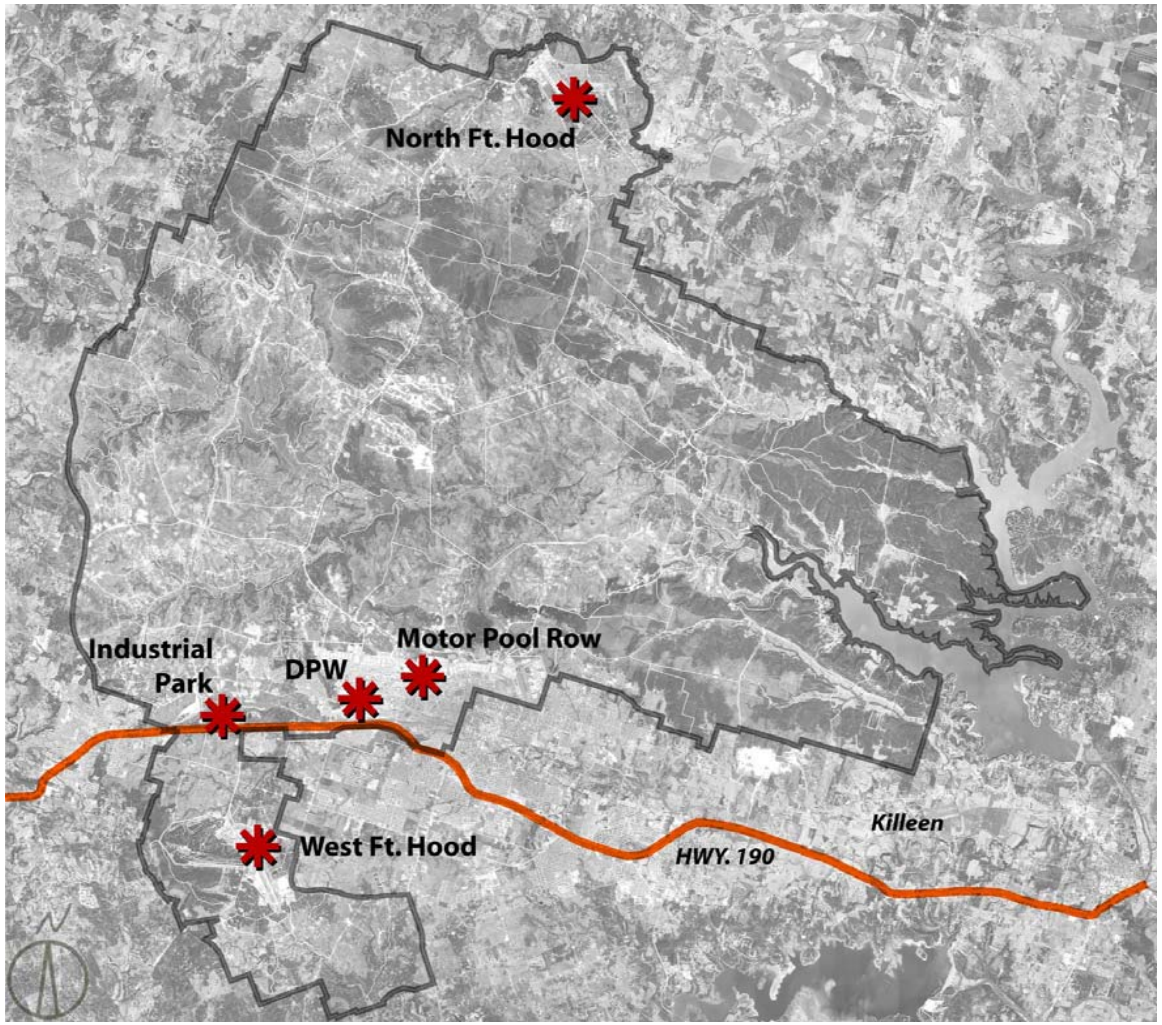


Figure 5-11 Maintenance and Warehousing Visual Zone Location Map

MOTOR POOL ROW

Reflecting the layout of the original master plan for Fort Hood, Motor Pool Row is expressed as a lineal organizational arrangement of maintenance functions, defined by the east-west streets of North Avenue and Hell on Wheels Avenue, also intersected by several cross streets, including Hood Road in the central portion of the sub area, Clear Creek Road on the western edge, and Martin Drive on its eastern edge.

Motor Pool Row grid layout.

The overall site layout and organization of this area is somewhat uniform and repetitive, reflecting the linear nature of the area's layout, which is further expressed as a grid reinforced by the cross street network. The site and functional organization of this area reinforces and responds to maintenance functions.

Buildings in this sub area generally reflect a "mission industrial" style, incorporating an industrial theme, which also includes some expression of an international style. The architectural style and character in this sub area are very uniform, and to some extent recessive, which provides a backdrop for more significant and contributing architectural features and buildings.

Low maintenance drainage.

Landscape development is purposely sparse in this and other maintenance and warehouse sub areas, given the utilitarian aspect of its functions and also lending to minimal maintenance practices. Gravel is often used as ground cover and offers a visual treatment that is more sustainable, and requires less maintenance, than plants. Drainage swales are often paved, which accentuates their presence.

The southern edge of Motor Pool Row, formed by Old Ironsides, has a pronounced streetscape expressed by a fairly continuous row of street trees along the corridor. These street trees further define the edge of the sub area, as well as proving a visual rhythm along this corridor.

New motor pool buildings continue the mission industrial style.

A consistent building setback responds to force protection requirements which, along with security fencing made of barbed wire, also define a linear edge with the motor pool and maintenance areas located predominantly behind the buildings. Figure 5-12 shows primary motor pool features identified during the visual zone analysis.

DPW (DIRECTORATE OF PUBLIC WORKS) AREA

The DPW area is located to the west of Hood Road and south of Battalion Avenue with easy access and proximity to U.S. Highway 190. The DPW area includes smaller scale temporary structures juxtaposed with some newer construction which, while providing some historical character, does not provide as positive a visual image as those buildings in Motor Pool Row. The predominant character of buildings in this area reflects more of a single purpose and utilitarian function. Many older temporary facilities have not been maintained; however, there are some larger warehouses that have been upgraded to current standards. While the roadway network in this sub area reflects a grid, it is not as linear in comparison to Motor Pool Row. Figure 5-12 shows primary DPW area features identified during the visual zone analysis.

Figure 5-12 Maintenance and Warehousing Visual Zone Analysis Map – Main Cantonment

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INDUSTRIAL PARK (POL AREA)

The Industrial Park area, located to the west of Clear Creek Road, is also characterized by an industrial character with facilities that express the function of fuel storage, as well as the marshalling and loading function, including large expanses of paving. Figure 5-13 shows primary POL Area features identified during the visual zone analysis. Figure 5-13 shows primary POL Area features identified during the visual zone analysis.

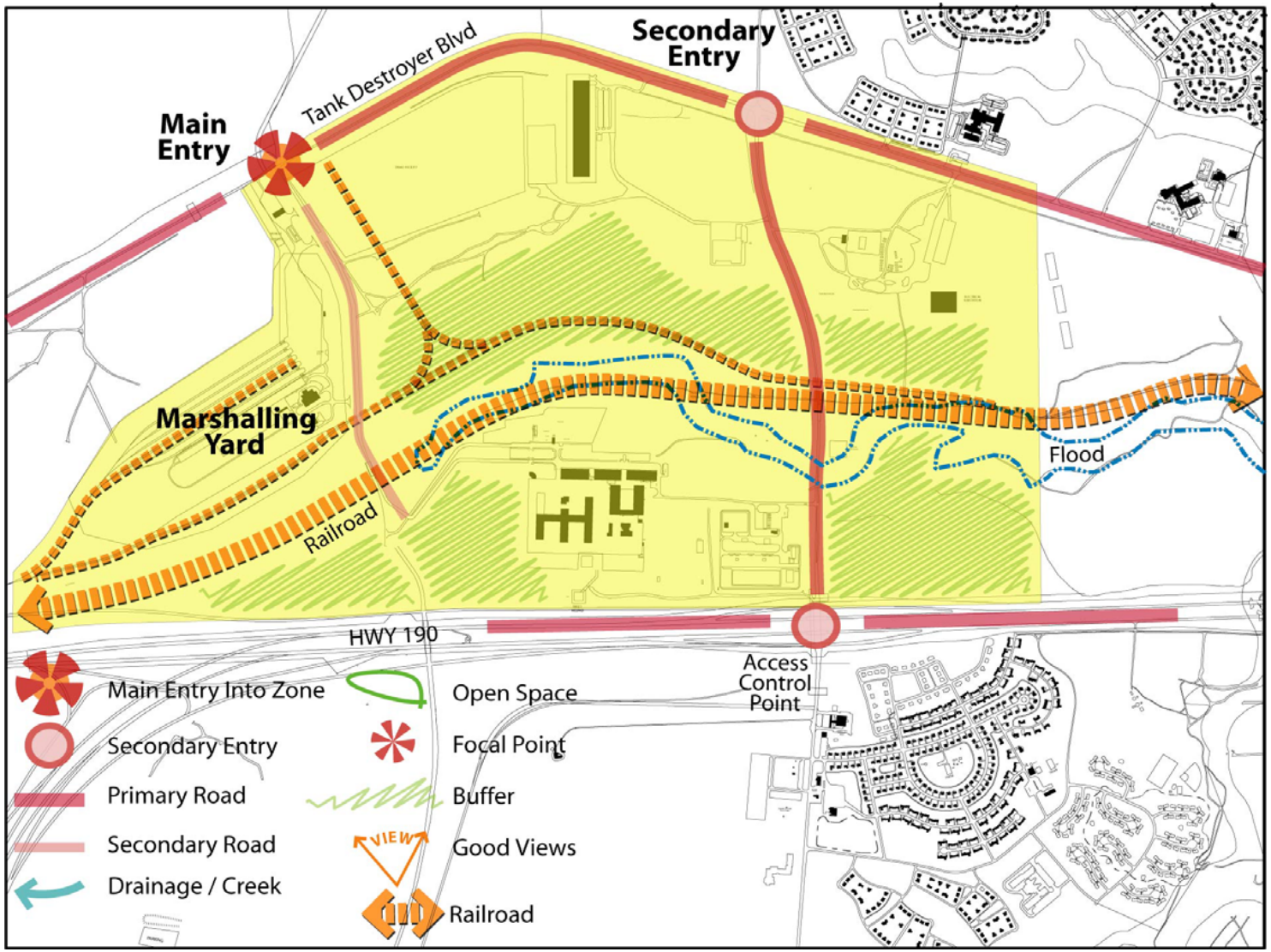


Figure 5-13 Maintenance and Warehousing Visual Zone Analysis Map – Industrial Park

NORTH FORT HOOD

North Fort Hood is in a state of transition with older facility areas being gradually redeveloped. The existing development and building form is also rectilinear, following a recognized grid of streets and cross streets. Building and architectural character reinforces the industrial functions performed in the facilities, with associated large expanses of vehicle parking and storage areas. Figure 5-14 shows primary North Fort Hood features identified during the visual zone analysis.

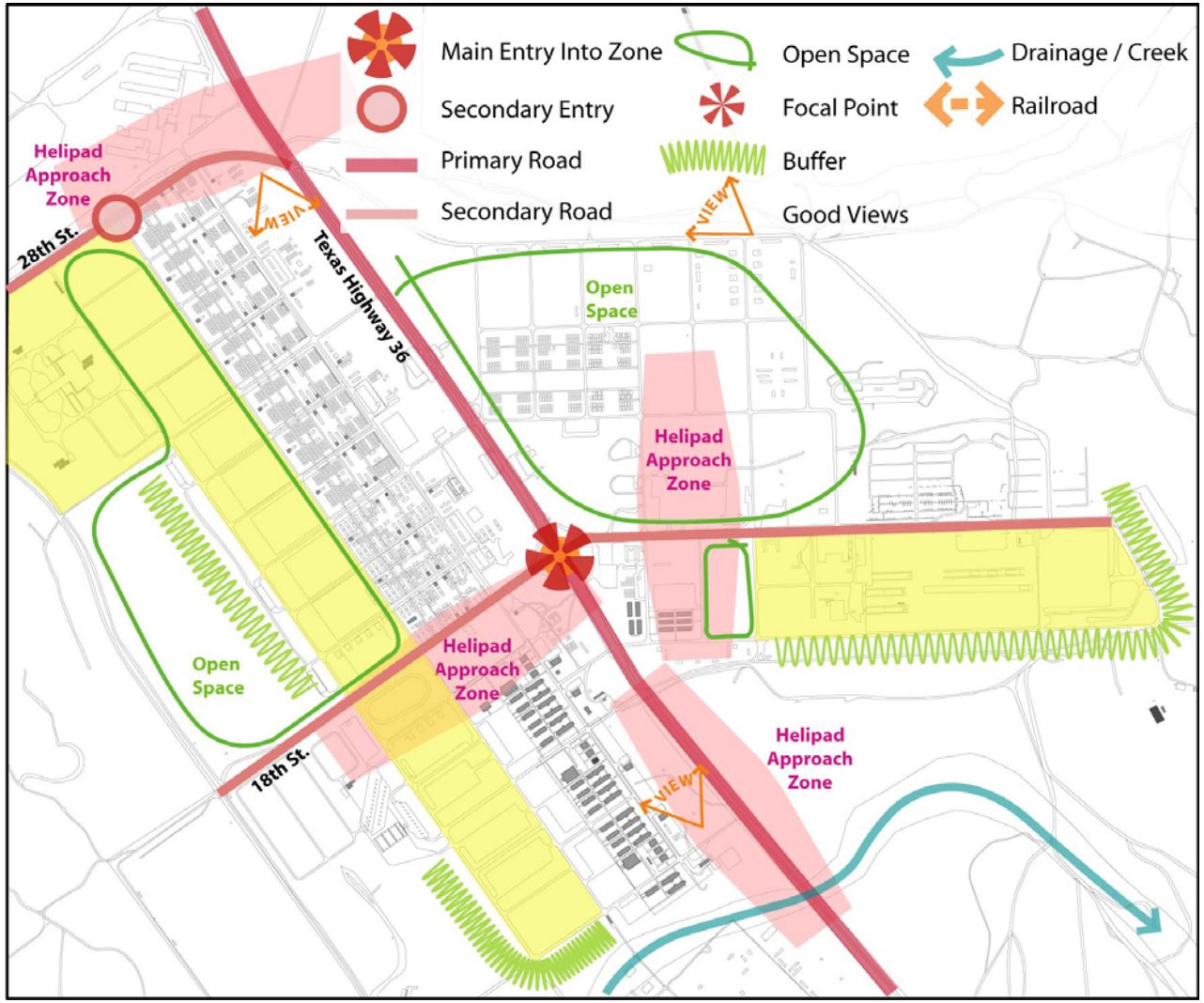


Figure 5-14 Maintenance and Warehousing Visual Zone Analysis Map – North Fort Hood

WEST FORT HOOD

West Fort Hood includes two motor pool sub areas adjacent to the joint use airfield. The visual character of these sub areas is consistent with their industrial function. Figure 5-15 shows primary West Fort Hood features identified during the visual zone analysis.

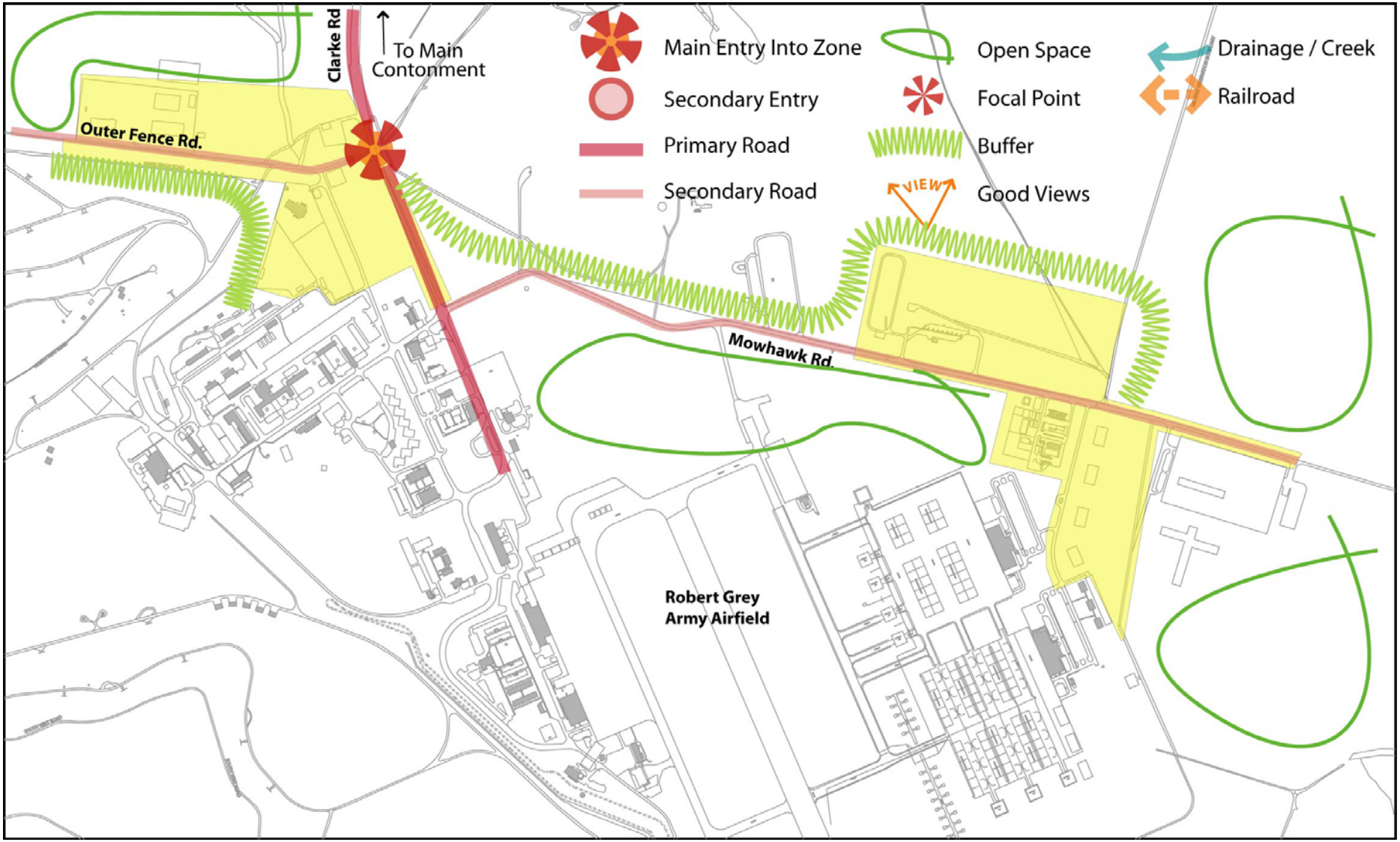


Figure 5-15 Maintenance and Warehousing Visual Zone Analysis Map – West Fort Hood

5.2.1.4 Rangeland Visual Zone

Training field.

Typical landscape character.

Tank training maneuvers.

The Rangeland Visual Zone is the largest zone on the installation and can be characterized by open fields and mixed vegetated woodlands, with topography that consists of gently rolling hills (Figure 5-16). The zone has multiple uses that benefit the overall mission of the installation, as well as the local community. A majority of the zone is used for training, including the use of live ordnance. While cattle grazing does occur within the range, land is not set aside for grazing use. At times, this mixed use conflicts with training maneuvers. Currently, land management practices are employed to manage this zone, as well as the animals that use the land for grazing. Circulation throughout the zone is accomplished via a mixture of paved, sand, gravel, and earthen roads.

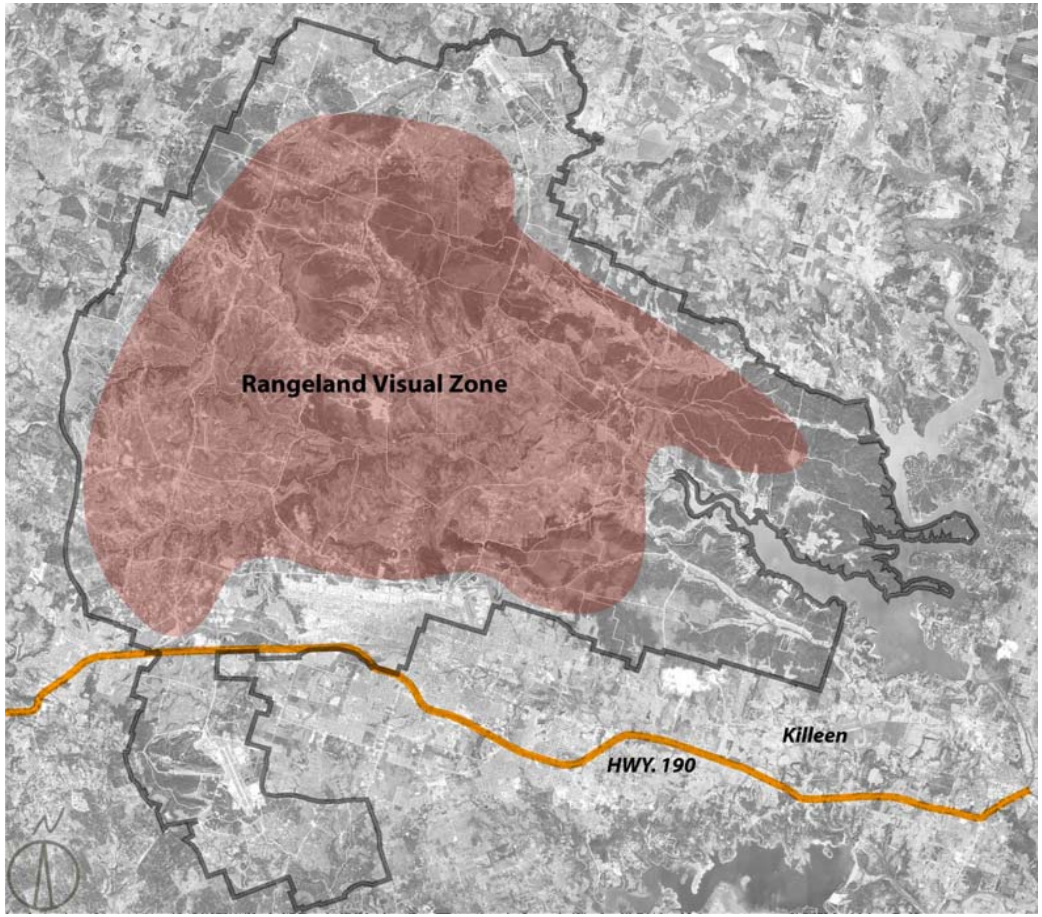


Figure 5-16 Rangeland Visual Zone Location Map

5.2.2 Community Core Theme

These areas represent the common sphere of activity between a soldier's life and that of a family residing on post. Specific functions include shopping, services, education, and religious activities. The community environment should be recognizable as a place of life, expressing community identity, interest and pride. The Community Core Theme has two distinct visual zones; the main cantonment, which is more urban in scale and density, and North Fort Hood and West Fort Hood, which are developed in a more traditional pattern that is typical of suburban residential areas (Figure 5-17).

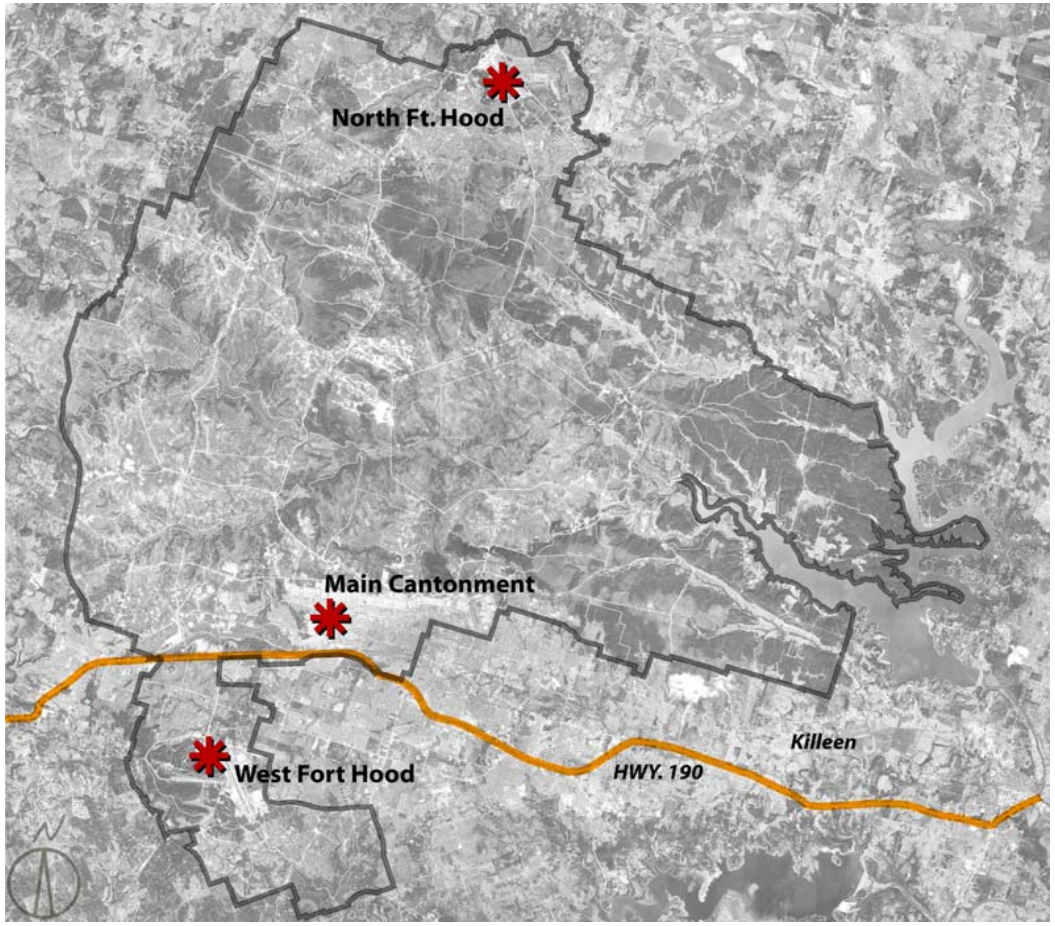


Figure 5-17 Community Core Visual Zone Location Map

5.2.2.1 Main Cantonment Community Core Visual Zone

Commissary building style.

Community Center style.

Movie theater with columns

New eating establishment

The Main Cantonment Community Core Visual Zone is diverse in use, yet unified in its architectural style and theme. Buildings are generally designed in the international style and organized in a linear fashion adjacent to troop housing and the main circulation grid layout. Similar to the other areas of the installation, the structures that lie within this zone vary in scale and complexity and range from traditional brick masonry of the established older structures to the most recent “Texana” style of natural stone. The visual character of this zone has traditionally been unified, but is beginning to depart from the established brick building materials and general look, with the addition of these recent support and commercial structures. The newer buildings have a greater sensitivity to a local regional Texas vocabulary and also exhibit a higher level of sustainability.

Buildings are supportive of their intended function; however, individual developments do not seem to connect or relate to each other. In some cases, the development is an urban scale and higher in density, allowing installation users the opportunity to walk to alternative support developments; however, even this development form promotes vehicular circulation, further reinforced by surrounding the structures with parking. Figure 5-18 shows primary Main Cantonment features identified during the visual zone analysis.

5.2.2.2 Suburban Community Core Visual Zone

The Suburban Community Core Visual Zone has several distinct areas: the commercial area on the west side of the main cantonment, which supports a majority of the family housing; a small development at North Fort Hood; and a similar development at West Fort Hood. The suburban community core at both North Fort Hood and West Fort Hood are very insignificant in size and scale. In general, the suburban feeling and automobile orientation of Fort Hood continues throughout these zones and the newer structures also reflect this planning pattern. Buildings are spaced in a lower density arrangement and with a lack of connection to each other, due to the vast amount of open space. Building landscaping is somewhat random, though prolific in some areas and lacking in others. Also, there does not seem to be a hierarchy or ordering of building, tree, or vegetation selection.

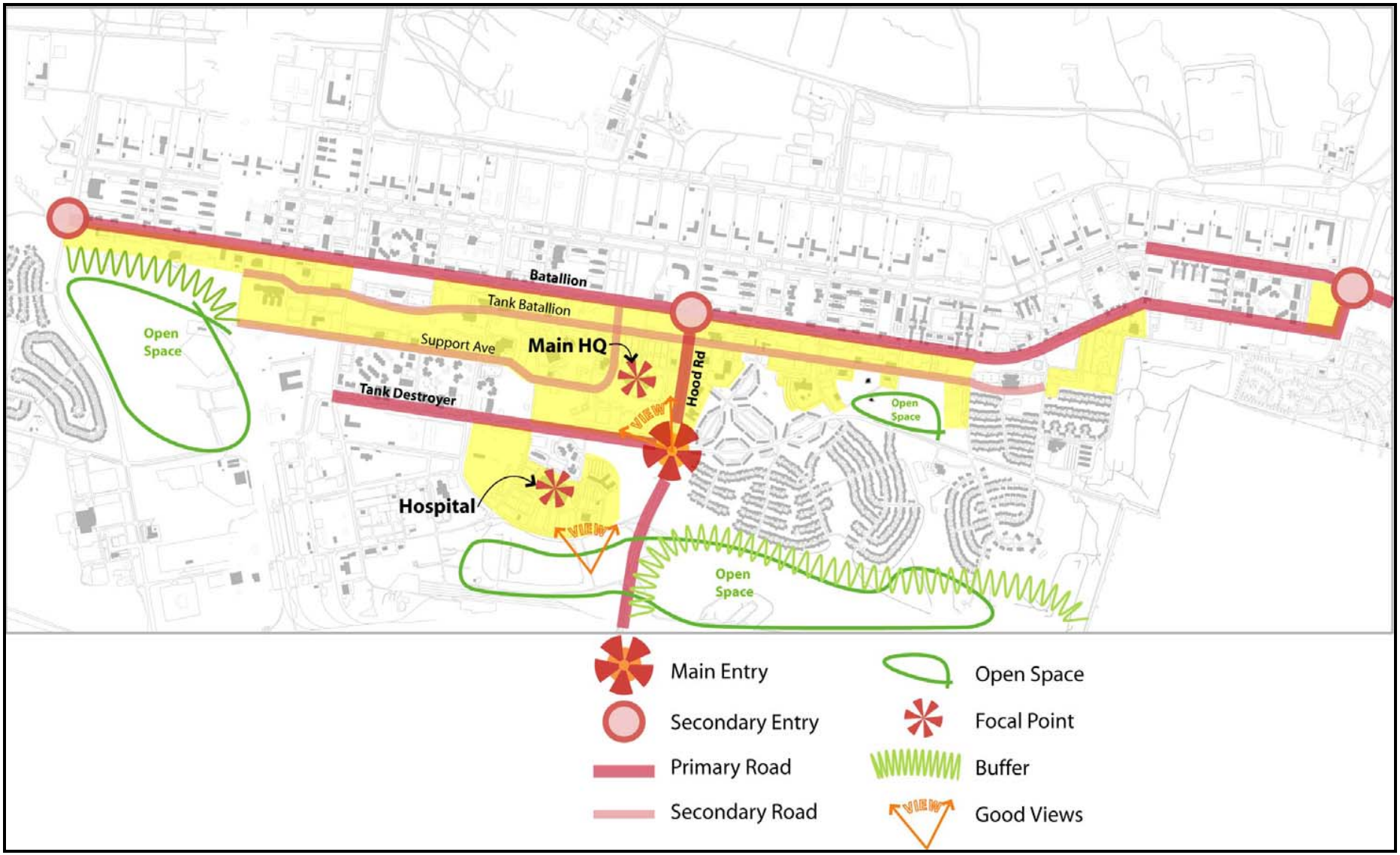


Figure 5-18 Community Core Visual Zone Analysis Map – Main Cantonment

The Suburban Community Core Visual Zones in both North Fort Hood and West Fort Hood are very small developments and, in some cases, is may be one building. The architectural style of the buildings is similar in nature to the facilities found in the main cantonment, only on a much smaller scale.

In both of these areas, the quality can be characterized as utilitarian, functionally efficient and of relative minor importance in evaluating the installation's aesthetic image. Consequentially, this plays a relatively small role in the visual image of Fort Hood. It is for these reasons that analysis maps for these zones are omitted.

West Fort Hood gas station.

West Fort Hood bank.

North Fort Hood shoppette.

West Fort Hood bank.

5.2.3 Recreational / Open Space Visual Theme

5.2.3.1 Parks and Open Space Visual Zone

This visual zone is generally adjacent to family housing and, in some cases, the Community Core. This location characteristic reinforces the use of these areas for recreation and support exercise, as well as family relaxation. These park areas also provide green space and visually open areas, adding to the overall quality of life on the installation. This zone can include urban recreation, such as in the cantonment area, as well as natural recreation which as exists at Belton Lake (Figure 5-19)

This zone's building architecture is characterized by vernacular regional style structures with gable roofs, native stone, heavy timber, and wood siding that fit well into the natural environment. Many smaller site elements also complete the zone; supporting children play areas and family picnic functions. Signage and lighting also are contributing architectural design elements of this zone and reinforce the vernacular style.

This zone's main function, beyond visual green space, is to provide a safe pedestrian and living linkage from the prominent automobile environment to the adjacent zones. This function is critical to the installation user as a relief to the working focus and adds to the feeling of a complete living environment. This zone must reinforce the installation's image as a friendly and comfortable place to work and live. These areas can best 1) utilize the Base's existing topography 2) become transition zones to family housing and 3) provide a buffer from the automobile, complimenting the natural environment. Structures within this zone should reinforce this visual theme, blend with the environment and support the recreational use they perform, visually and physically linking housing with commercial support functions.

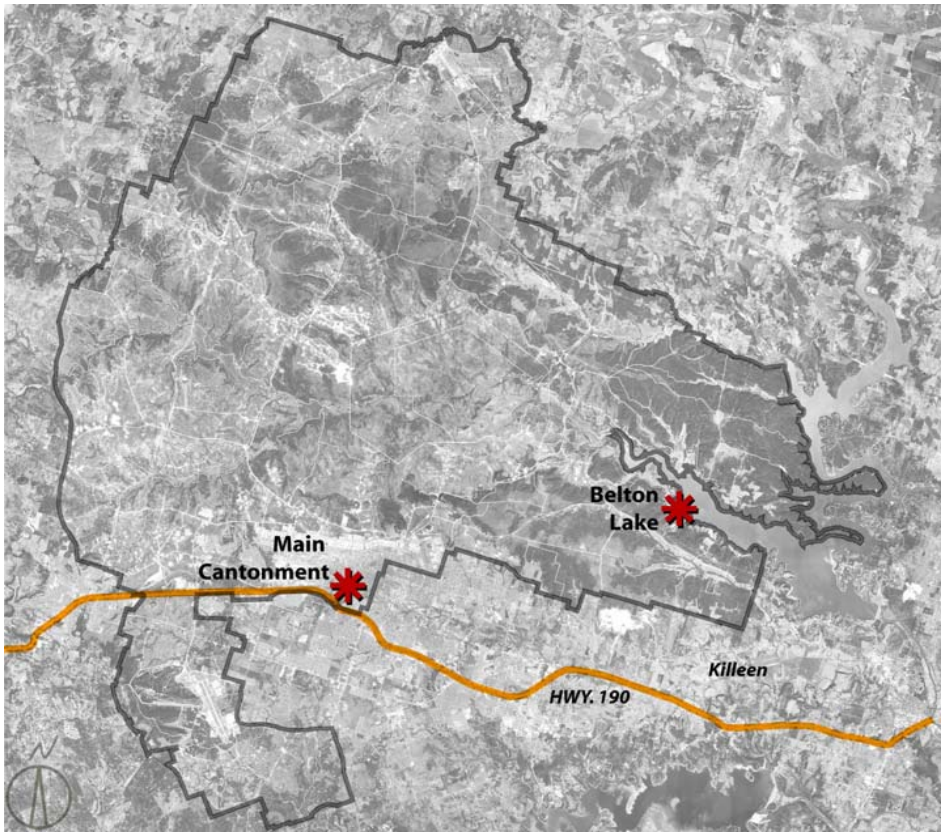


Figure 5-19 Parks and Open Space Visual Zone Location Map

The environment should be distinguished as a place of relaxation and refreshment. Each sphere of activity can be represented as a specific design program to be promoted through application of the various goals of the individual design components. As each design program is addressed, it should be recognized that the design components will have varying significance in definition of the theme image. For example, architecture will necessarily have the greater impact on the definition of any theme due to its importance as an image determinant. Other design components will vary in significance depending on the theme. Figure 5-20 shows primary open/park space features identified during the visual zone analysis.

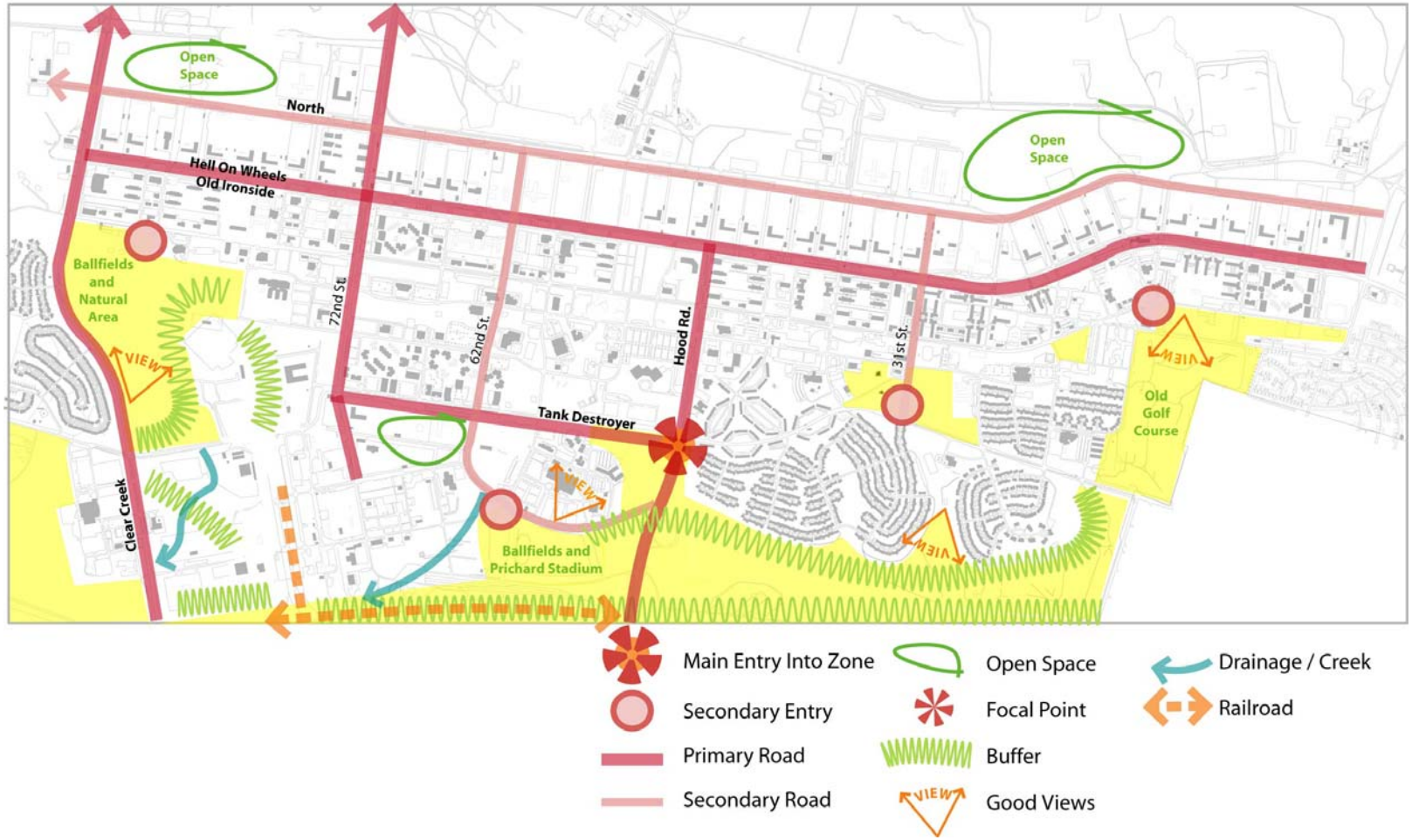


Figure 5-20 Parks and Open Space Visual Zone Analysis Map – Main Cantonment

5.2.4 Residential Theme

5.2.4.1 Residential Visual Zone

For the purposes of this analysis, the Residential Theme relates to the Residential Visual Zone throughout the installation. The place of residence should offer pride, comfort and a sense of relief from the workplace. There are three main residential areas located on Fort Hood. The two largest residential areas are on the main cantonment, one located near Hood Army Airfield and the other to the west of the main cantonment. The third residential area is located at West Fort Hood (Figure 5-21).

The main residential areas are located on the main cantonment near Fort Hood Army Airfield on the eastern end of the main cantonment area and Robert Gray Army Airfield at West Fort Hood. Residential vernacular is the description used here for the various residential area themes. In many ways, the basic form of this theme has a direct relationship to the various vernacular influences throughout Texas. The homes are comfortable although not “high architectural” design. Through the years, the homes have been simplified, remolded and economized into today’s vision of suburban America. The residential neighborhoods seem fairly well-maintained and cared for as family enclaves.

The remainder of the residential housing encompasses all of the family housing on Fort Hood, which occurs in several locations surrounding the main cantonment. The more established residential neighborhoods exhibit sound construction techniques, mature

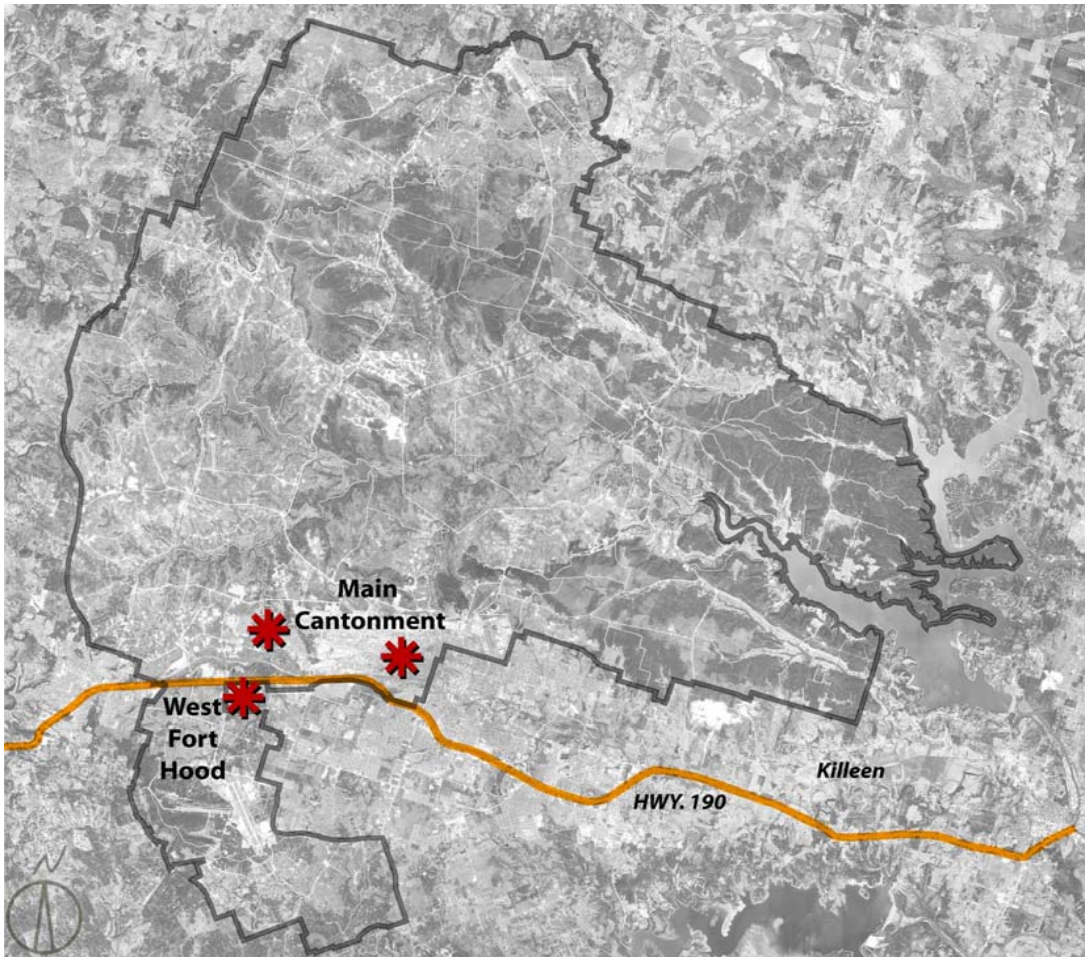


Figure 5-21 Residential Visual Zone Location Map

Older, single-family housing.

Older, multi-family housing.

New multi-family housing.

Typical recreation at housing.

landscaping and a well-maintained environment (e.g., Patton Park, Walker Village, and Montague Village). Overhead utility lines have been placed in alleys or interior easements, which results in a pleasant visual image throughout the housing areas. The curvilinear street patterns and conscientious, if not consistent, use of site furnishings have further enhanced the neighborhood flavor of these areas.

More recent residential developments, such as the Comanche neighborhoods, exhibit a less distinctive and complete character due to undeveloped landscaping, despite fairly appealing site plans and building facades. Many of these neighborhoods lack distinguishing features, which enhance and complete the environment including: emphasis of the neighborhood entry with landscaping and signage; unifying site systems elements (e.g., mail boxes, lighting, fences, kiosk, and bush shelters); street trees; and common activity areas. The quality of this residential zone is high.

This visual zone generally surrounds the main cantonment and is comprised of multiple residential neighborhoods. Linked to the chronological development of the installation, these neighborhoods vary from well-established, older, traditional developments to very recent, which also relates to a varied visual character.

Patton Park, Walker Village and Montague Village exhibit mature landscaping and a general feeling of well-established, single- and multiple-family residential neighborhoods. The Comanche Village neighborhoods are more recent and, therefore, lack the maturity of landscaping and neighborhood development. These developments also lack some of the basic planning elements that could enhance their character and quality of life.

Generally, residential buildings should look and feel like typical American housing developments. Fort Hood has adopted a suburban character for its family housing and, therefore, standard-planning fundamentals should apply. These consist of development entries, gable roof forms, housing scale modules with inviting entries, traditional yards, fences and porch elements, sidewalks, landscaping and street character with appropriate lighting, signage and furnishings.

The most recent Comanche Village developments capture the character of a suburban Texas neighborhood with material selections of stone and siding and incorporate front yard landscaping, which will enhance the long-term visual character of this housing. Figure 5-22 shows primary residential features identified during the visual zone analysis.

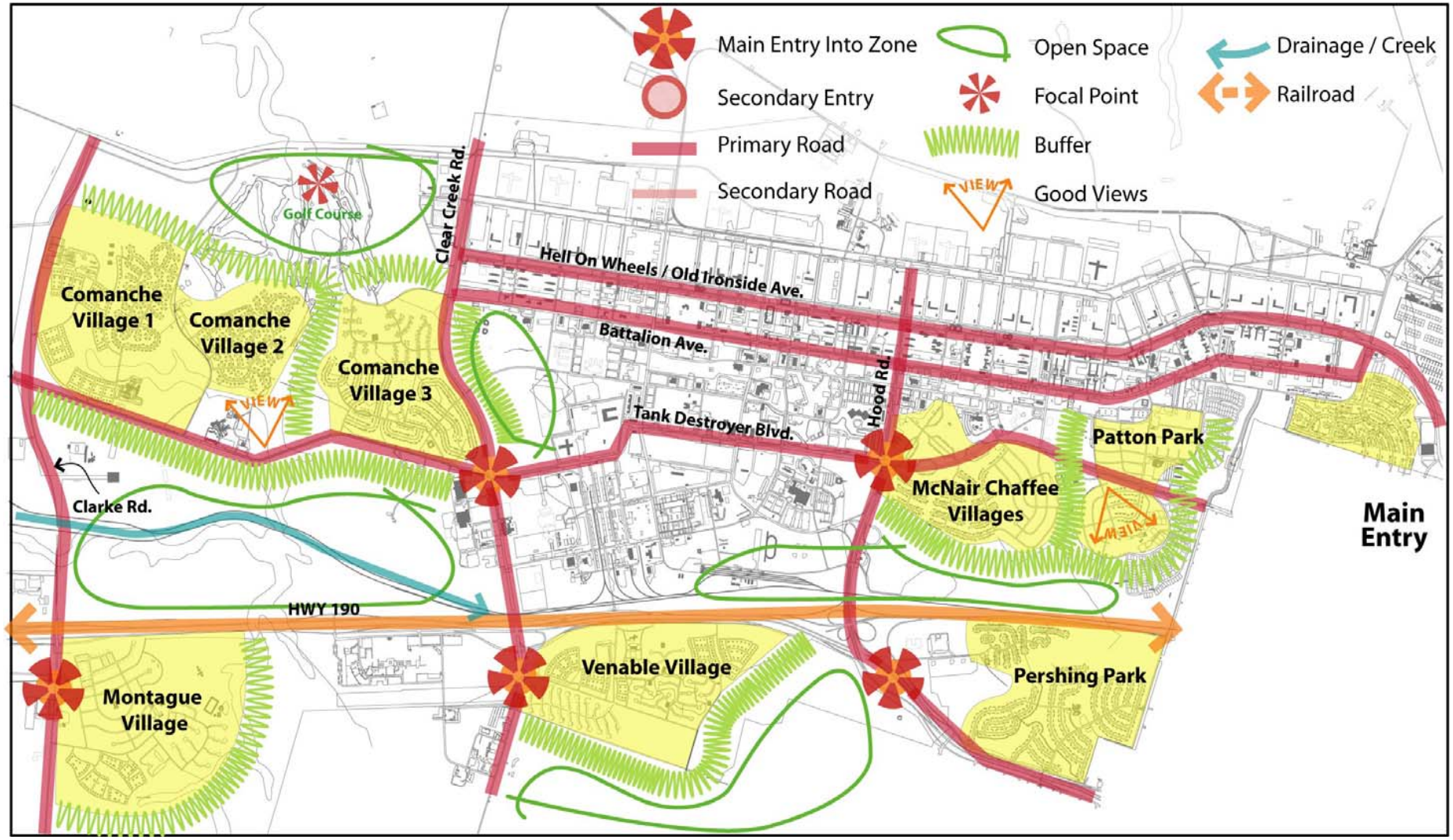


Figure 5-22 Residential Visual Zone Analysis Map - Main Cantonment and West Fort Hood

5.3 ASSETS AND LIABILITIES

Assets and liabilities are correlated to the visual description of each visual zone and form the basis of recommendations for improvements to achieve the future needs to support the Fort Hood Mission. Both the visual description and recommendations for each visual zone relate to the six design components of the design principles and visual elements described within this Installation Design Guide. These are:

- Site Planning
- Buildings
- Circulation
- Plant Material
- Site Elements
- Force Protection
- Liabilities

Table 5-1 depicts each zone as it relates to the six design components, noting whether the component is an asset, a liability, or has no relationship or effect.

Table 5-1 Zone Asset and Liability Matrix

	ZONE						
Asset Elements	Airfield	Troop Housing	Maintenance and Warehousing	Rangeland	Community Core	Parks and Open Space	Residential
Adequate vehicular circulation			+			+	+
Appropriate adjacencies to other buildings	-	+	+		-		+
Appropriate building footprint sizes and heights		+					+
Appropriate lighting to pedestrian scale	-	+	-		-		+
Appropriate recreation elements and design		+			-	-	-
Appropriate screening of visually poor amenities		+	-		-		+
Appropriate setbacks from road		+	+		+		+
Appropriate shading in parking areas	-	-	-	-	-	-	+
Appropriate signage for circulation		+			-		+
Appropriate site planning of buildings and elements	+	+	+	+	-	-	+
Appropriate visual character	+	+	+	+	-	+	+
Architecture creates interest		+	+		-		-
Building functions are consolidated	-	+	-		-		
Buildings create interesting streets		+	-		-		-
Buildings front roads		+	+		+		+
Clearly articulated entrances to buildings	-	+	-		+		+

Key: **+ is an asset**
– is a liability

Table 5-1 Zone Asset and Liability Matrix

Asset Elements	ZONE						
	Airfield	Troop Housing	Maintenance and Warehousing	Rangeland	Community Core	Parks and Open Space	Residential
Common gathering areas for pedestrians		+			-	+	-
Consistent landscaping	-	-			-	-	+
Consistent materials throughout area	+	+	+		-	-	-
Current recreational equipments		-	-		-	-	-
Designed for ADA	-	-	-		-	-	-
Earth tone vernacular (color) of facades	+	+	+	+	+	+	+
Force Protection elements meet standard	+	-	-		-		+
Form follows function of building or element	+	+	-		-		+
Good building upkeep	+	+	-		-		+
Good circulation (pedestrian)	-	+	-		-	+	+
Good circulation patterns (vehicular)	-	+	+		+		-
Good connections to surrounding amenities		+			-	-	-
Good entry areas	-	+	-		+		+
Good focal points		-			-		
Good outdoor gathering spaces	-	+	-		-	-	-
Good streetscaping	-	+	-		-	-	-

Key: + is an asset
– is a liability

Table 5-1 Zone Asset and Liability Matrix

	ZONE						
Asset Elements	**Airfield**	**Troop Housing**	**Maintenance and Warehousing**	**Rangeland**	**Community Core**	**Parks and Open Space**	**Residential**
Good pedestrian amenities	-	+	-		-	-	-
Good signage	-	-	-		-	-	-
Good site amenities	-	-	-		-	-	-
Good site element design	-	+	-		-	-	+
Good stormwater management		+	+		-	-	
Good upkeep and general care of area	+	+	-		-	-	+
Good variation of buildings	-	+	+		-		+
Good visual character	+	+	+		-	+	+
Good building placement	+	+	+		-		+
High quality construction	+	+	+		-		+
Historic structures are present		+	+		+		
Interesting architecture themes		+			-		+
Local vernacular (materials and style)					+		
Low maintenance planting schemes	+	-	+		-	-	
Mature trees provide shade	-	+	-		-	+	+
Multi-story construction footprint		+	-		-		+

Key: **+ is an asset**
– is a liability

Table 5-1 Zone Asset and Liability Matrix

	ZONE						
Asset Elements	**Airfield**	**Troop Housing**	**Maintenance and Warehousing**	**Rangeland**	**Community Core**	**Parks and Open Space**	**Residential**
Natural areas		-		+	-	+	+
Natural drainage used for stormwater	-	-	-	+	-	+	+
Open space areas		+		+	-	+	+
Pedestrian scale lighting		+			+		+
Perimeter fencing	+		+				
Road design produces appropriate speeds		-	-		-		+
Screened utilities		+	-		-		
Shaded public areas (parking, picnic, etc.)		+	-		-		-
Sidewalks promote easy circulation	-	+	-		-	+	+
Strong visual hierarchy	+	+	+		+		
Sufficient amount of parking		-	-		+		+
Wildlife habitat areas				+		+	-
Works well with adjacent land use	-	+	+		+	+	+

Key: **+ is an asset**
– is a liability

5.4 RECOMMENDATIONS

Recommendations respond to identified assets and liabilities to improve the overall visual quality of the installation in support of development and master planning goals. Recommendations form the basis of the priority improvement projects (PIPs) documented in Section 6 and which correspond to the component of site planning, buildings, circulation, plant material, site elements, and force protection. Incorporating sustainability into the future development of Fort Hood was paramount in the development of the recommendations.

5.4.1 Airfield Visual Zone

Site Planning

- Standard planning fundamentals should apply to this area and should consist of entry announcement, strong functional relationships between aircraft housing and maintenance, and enhanced pedestrian movement corridors to vehicles.
- Additional pedestrian linkages, with street lighting and appropriate signage, can enhance the functional efficiency of this zone and promote better connections to all installation facilities.
- Priority visual areas should be in the vicinity of the operations and administration facilities and the airfield towers.

Buildings

- Coloration and signage can unify this visual zone, with buildings designed and organized to maximize their function and accommodate various army aircraft, maintenance and warehousing.
- Architectural style should be mission industrial.
- Pitched roof forms should be interspersed with flat-roofed structures to provide interest, while a varied visual continuity is provided by materials, open spacing, treatments, and details.
- Exterior coloring on the buildings should be a light brown and tan to beige tone brick, although colored poured or pre-cast concrete tinted to warm beige may also be used.

- Windows on sun exposures should be inset for solar protection.

Circulation

- Areas of improvement opportunity include better signage and strengthened pedestrian linkages to the main cantonment areas.
- Simplify collector road circulation to ease the ability to navigate the airfield zones.
- A symbolic gateway arrival to Hood Army Airfield along Warrior Way would further enhance the passage into this portion of the visual zone.

Plant Material

- Plant native species that will reduce maintenance and water consumption throughout the zone.
- Minimize the use of grass due to high maintenance and water consumption.
- Plant native trees around parking lots and buildings to provide shade and energy efficiency.
- General facility and grounds maintenance and upkeep will contribute to the overall visual image of this major asset area.
- Plant materials should be used as a buffer to reduce noise from the airfield to the surrounding zones such as residential and other uses that may be conflicting with the airfields.

Site Elements

- Site elements should be focused around support facilities to minimize land consumption, promote physical activity, such as walking, and generally be more sustainable.

Force Protection

- Increase force protection of north airfield.

5.4.2 Troop Housing Visual Zone

Site Planning

- New development should be planned as dense as appropriate, close to the support facilities to minimize land consumption, promote physical activity, such as walking, and generally be more sustainable in nature.
- The proximity of the housing to the street is governed by force protection planning criteria; however, it is recommended that housing units be sited as close to the street as possible to promote a defined street character zone and allow for pedestrian engagement.

Buildings

- The existing architectural vocabulary in this zone will be continued; however, unique, individualized complex character should be promoted in future developments where possible.
- Building materials will remain consistent and reflect the currently well-established palette, reflecting the stability and strength of Fort Hood's continued development.

Circulation

- Incorporate sidewalks throughout the area.
- Continue shared use parking lots for multiple buildings and areas.
- Continue the one-way boulevard primary circulation pattern in the main cantonment area.

Plant Material

- Incorporate an organized streetscape planting strip between building and street in addition to incorporating native plant material.
- Continue the informal clustering of plant material in common areas.
- When specifying plant material, choose species that are suited to the type of maintenance provided (i.e., troop maintenance in lieu of professional maintenance).
- Incorporate formal planting schemes in high priority areas such as headquarters or company operations areas.

- Incorporate planting of trees in parking areas to improve shade and reduce the heat island effect.

Site Elements

- Install utilities underground where feasible.
- The application of a unified and consistent system of site elements will create a sense of continuity throughout the zone.
- Incorporate Physical Training (PT) elements into common areas.

5.4.3 Maintenance and Warehousing Visual Zone

Site Planning

- The application of a unified and consistent system of site improvements in this zone will do much to create the image of a unified, single purpose complex. In addition, the sprawling nature of the site layouts in this zone will seem less overwhelming by the addition of a consistent system of site improvements.
- Use the Motor Pool Row example of site planning as the example for future development in this zone.

Buildings

- Architecture should be simple, straightforward, of a high quality image, comfortable to users, and compatible with the environment.
- The architecture should continue in the mission industrial style.

Plant Material

- Incorporate native plant material along roadways, parking lots and appropriate buildings.
- Plant open, vacant lots with a low-growing, native ground cover which does not require much water or maintenance.

- Consider planting drainage ways with appropriate plant material versus using a paved treatment to slow the velocity of the water runoff and allow for percolation into the ground and eliminate massive erosion.

- Use of xeriscape plantings is most appropriate for this zone since these sites cannot or need not be landscaped and maintained at the same level as in other zones. This style emphasizes minimal water usage and minimal maintenance.

Site Elements

- Site elements should conform to the mission industrial style, thus, when combined with buildings in this style, the forms, materials and details of the site furnishings will contribute toward a stronger visual statement.

- Site elements should exhibit a simple, straightforward form and expression of materials and function. Forms should be strong, monolithic rectangles with clean lines to blend with the sense of purpose in the mission setting.

5.4.4 Rangeland Visual Zone

Best Management Practices (BMPs) for land management should be continued to be used. The installation should continue to work towards a more agreeable arrangement with the cattle grazing and training maneuvers. The use of clear signage should be used to direct personnel to their specific area clearly and concisely. Protecting, maintaining and enhancing vegetative riparian buffers through landscape practices should be implemented for the protection of Fort Hood's streams and drainage corridors. These buffers can reduce harmful effects of landscape disturbance and provide important habitat for birds and animals, as well as shade for fish. All training operations and grazing should remain outside of riparian buffers with a minimum buffer/setback width of 50-100 feet on either side of the stream.

5.4.5 Community Core (Main Cantonment and Suburban) Visual Zone

Site Planning

- Screen service areas to hide service access and unpleasant views that detract from the aesthetic value of the zone.

- Standard planning fundamentals should apply to this zone, including appropriate scaling of building development, well-defined entries, sidewalks, landscaping and street character with appropriate lighting, signage and street furnishings. In the denser areas of this zone, buildings should relate to each other and reinforce pedestrian activities.

- New developments should be planned with greater density to minimize land consumption, promote physical activity, such as walking, and generally be more sustainable.

- Street character should be enhanced and developed along Battalion Avenue and Fort Hood Drive, building upon many visual assets in this zone, while reinforcing a hierarchy to the roadway system.

Buildings

- New developments should follow the planning guidelines of the latest urban village design approach. These consist of defined development entries, building hierarchy of design and scaling, unique and focal point elements, character, abundant landscaping, topographic sensitivity, connectivity of structures and planning, appropriate street landscaping, lighting and furnishings.

- Commercial structures in this zone should be designed to stand out more than the traditional office and administrative vocabulary.

- Unique roof forms and added architectural elements relating to the function should create punctuations in the architectural expression.

- A Texas regional design approach with material selections of natural stone and metal should define the variety of uses in this zone.

- The previous international style architectural vocabulary should be continued for administrative buildings. However, unique, individual commercial structures should be promoted for differentiation and variety of future developments in this zone.

Circulation

- Clearer signage will reduce confusion when moving throughout this zone.

- The physical presence of automobiles could be balanced with more walkable, pedestrian-friendly environments.

Plant Material

- A focus on landscaping and overall streetscaping will unify this zone and connect it with the adjacent troop housing.
- The current natural earth tone color scheme and palette of building materials is consistent with expectations of typical Texas developments.
- There is a general lack of consistent landscaping in some of the developments and, thus, an opportunity to green the installation.

Site Elements

- The application of a unified and consistent system of site elements will create a sense of continuity throughout the zone. Such an application will provide visual linkages, which transcends the mixed architectural quality.

Force Protection

- The use mature vegetation is integral as part of force protection setback standards that will enhance the zone's aesthetics.

5.4.6 Parks and Open Space Visual Zone

Site Planning

- The installation lacks an overall feeling of pedestrian focus and outdoor activity. As such, these areas can add to the visual perception of a complete lifestyle and meaningful relaxing environment, supportive and balancing the main mission of the installation.
- All recreational zone activities should be connected to housing and living functions.
- New and existing facilities should follow the planning guidelines of traditional recreational support development with defined passive and active facilities, grouped to maximize efficiency and land utilization.

- These areas should have unique character, abundant landscaping, topographic sensitivity, safety considerations, appropriate street landscaping, abundant lighting and appropriate furnishings.
- New open space developments should be planned close to housing to facilitate supervisory areas and be very well connected with walkways. These facilities can also promote physical activity, such as walking, and generally be more environmentally sustainable.
- Standard planning fundamentals include strong vernacular expression of form and material, clarity and safety of access and use, housing scale, inviting site plan arrangement and logical placement on the installation to reinforce their use and visual presence.
- Sidewalks, access paths, appropriate lighting and abundant landscaping should be present to fully compliment the buildings and site elements.

Buildings

- Cluster and consolidate building usage.

Circulation

- Provide adequate parking for all amenities.

Plant Material

- Plant trees and other plant material to provide shade for users of the recreational areas.

Site Elements

- Add drinking fountains to recreational areas to provide water for users.
- Provide an adequate number of ball fields to keep up with the demand of users.
- Use appropriate materials for the type of climate, including the use of safety surface materials, to prevent harm to users due to heat and sun.

Force Protection

- Fencing and protective devices should be used for all areas to protect all users of any age.

5.4.7 Residential Visual Zone

Site Planning

- These units should take advantage of the natural topography and be connected to the open space development of the neighborhood (e.g., play grounds, pavilions, etc.).
- New developments should be planned close to support facilities to minimize land consumption, promote physical activity, such as walking, and generally be more sustainable.

Buildings

- New housing developments should follow the planning guidelines of traditional suburban development with defined development entries, unique housing development character, abundant landscaping, topographic sensitivity, privacy considerations, appropriate street landscaping, lighting and furnishings

Circulation

- Improve signage to reduce confusion and access issues.

Plant Material

- Use plants to screen unsightly areas such as dumpsters, garbage cans and other aesthetically unpleasing amenities.
- In the later Comanche Village developments, landscaping could be added to the grassed area between the sidewalks and the street curb. This will develop street character, soften the neighborhood feeling and minimize the openness of the street right-of-way.

Site Elements

- Improve site amenities such as bus stops, benches, and water fountains to make the area more pleasant to use.

Force Protection

- Have controlled access to the residential areas such as card swipe gates or remote controlled gate access.

5.5 FUTURE VISUAL THEMES AND ZONES

The Future Visual Zones Map incorporates known development that is currently in progress at Fort Hood and/or is a component of the overall master plan. To keep current with the ongoing development of Fort Hood, it was important to move past the current visual themes and zones and address the future development of the installation. Figure 5-23 through 5-25 on the following page depicts the future visual zones and should be the guiding map to apply all design guidelines.

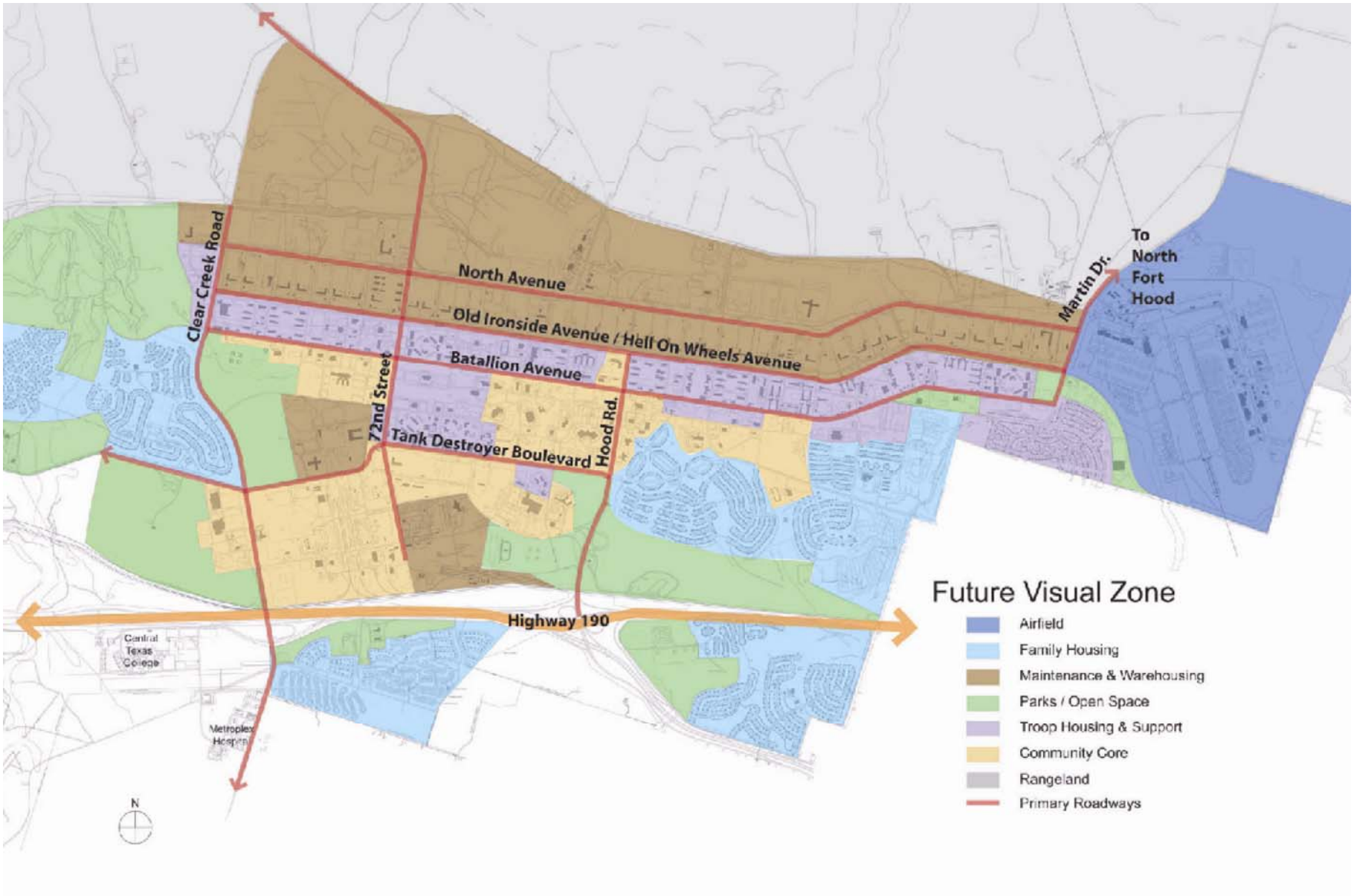


Figure 5-23 Main Cantonment Future Visual Zone Map

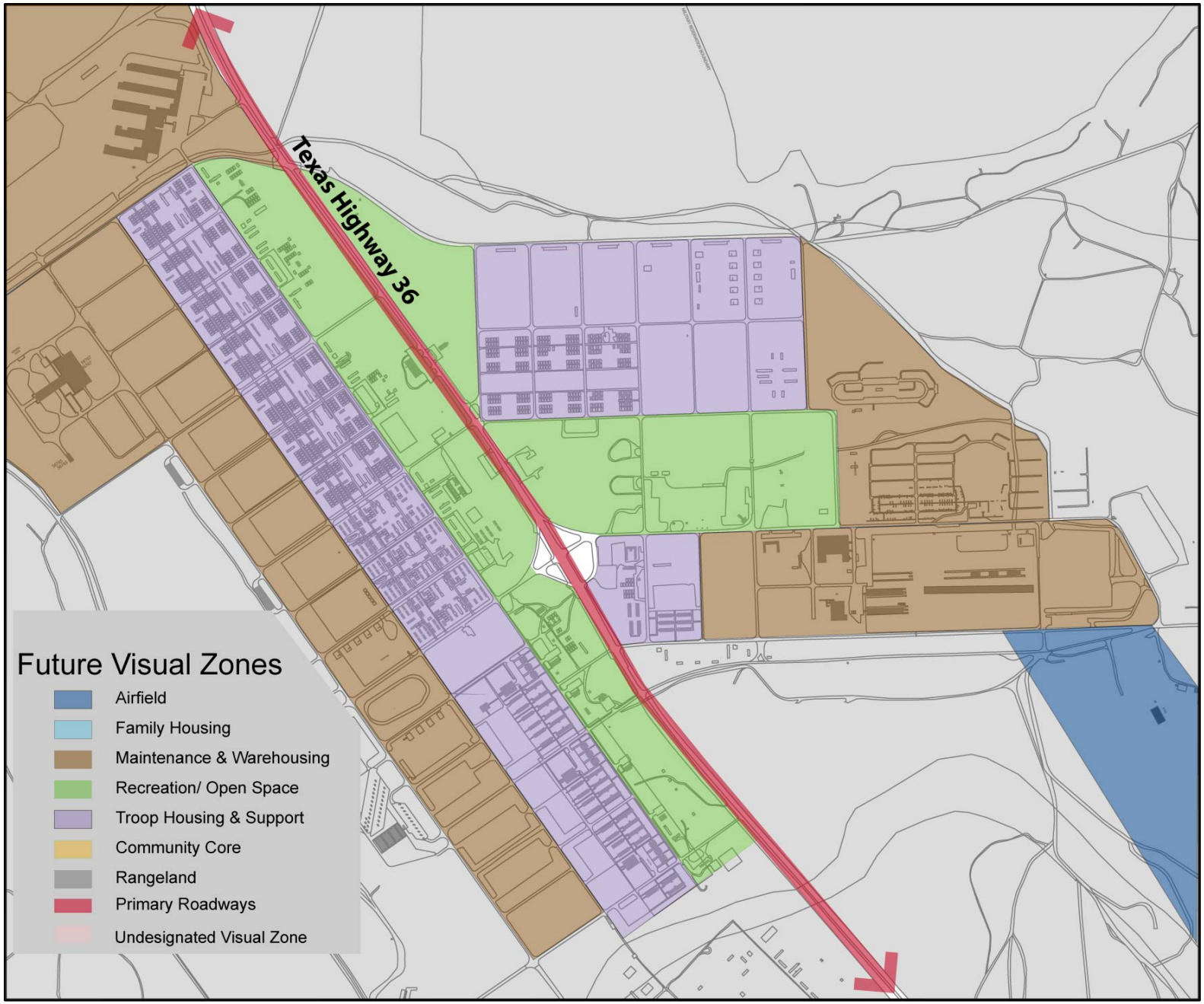


Figure 5-24 North Fort Hood Future Visual Zone Map

Figure 5-25 West Fort Hood Future Visual Zone Map

The priority improvement projects discussed in the section were developed through analysis of visual zones and locations of preference by Fort Hood. Each project focuses on a defined area of Fort Hood and provides recommended actions for improvement that are consistent with the IDG. An estimated cost for each project is included in provided at the end of this chapter (6.24) in Table 6-1.

6.1 PRIORITY IMPROVEMENT PROJECT NO. 1 - HOOD ROAD CORRIDOR

Existing Conditions

Hood Road is the main entrance into Fort Hood for all visitors and provides the most direct route to the III Corps Headquarters building from Highway 190. The III Corps Headquarters building represents one of the most key focal points at the installation and its prominence as the main point of decision-making should be reinforced through a strong and formalized Hood Road corridor. Many portions of Hood Road today appear fairly barren with minimal landscaping and no defined streetscape edge. The signage is uncoordinated and does not adequately direct or channel visitors to key areas at the installation.

Add uniform landscaping to further define street edge and help conceal overhead utility lines.

Project / Design Concept Description

The intent of this improvement project is to emphasize Hood Road as the formal corridor into the installation while creating an overall positive visual image.

1. Where feasible, create shallow depressions for micro-detention in all planted areas and install a uniform single row of street trees (Plateau Live Oak) 30 feet on center, from the main gate area to Hell on Wheels Avenue, excluding the area adjacent to the III Corps Headquarters building. Install landscaping and maintain as specified in the Fort Hood IDG.

2. Provide a sense of entry through the use of berming, formal entry signage, clustering of trees, shrubs, and flowers.

3. Provide directional signage to direct visitors to key areas throughout the installation.

4. Develop a formal planting plan at the Tank Destroyer Boulevard and Hood Road intersection that includes trees, shrubs, and flowers.

5. Coordinate all Hood Road Corridor improvements with the following: a) new double right-turn lane on eastbound Tank Destroyer Boulevard at Hood Road, new dedicated right turn lane southbound Hood Road approach to Battalion Avenue, b) new double left-turn lane on northbound Hood Road at Battalion Avenue, c) new right-turn lane southbound Hood Road at 461st Tank Battalion Avenue, and d) new double left-turn lane on northbound Hood Road at 761st Tank Battalion Avenue

Coordinate intersection improvements with corridor enhancement.

6.2 PRIORITY IMPROVEMENT PROJECT NO. 2 - CLEAR CREEK ROAD CORRIDOR

Existing Conditions

Berming and groups of shade trees will help define street edge and help screen undesirable views, such as the overhead utility lines.

Clear Creek Road is a secondary entrance into Fort Hood and is the main access point for those wishing to use the Clear Creek Commissary and Main Post Exchange. This corridor is also the primary means for all Fort Hood employees to gain access. Currently, along the west side of Clear Creek Road between Highway 190 and Tank Destroyer Boulevard is a key focal point of commercial activity that visually resembles a large civilian shopping center. The visual problems of this corridor include: large expanses of unscreened asphalt parking, little or no corridor landscaping and no defined street edge, poor directional signage that does not adequately direct or channel visitors to key areas at the installation, lack of screening of industrial uses to the east and no pedestrian access provided to the Clear Creek Commissary and Main Post Exchange.

Project / Design Concept Description

The intent of this improvement project is to improve the overall visual character of this corridor, enhance vehicle and pedestrian circulation, and improve directional signage. This secondary entrance corridor will receive a more naturalistic landscape enhancement replicating how the plants might be found in a natural setting.

1. Install berms in key areas to provide screening of undesirable views.
2. Create shallow depressions for micro-detention in all planted areas and install native shade trees (Plateau Live Oak) and shrubs throughout corridor. Use excavated soil from shallow depressions for creating the berms in No. 1 above. Install landscaping and maintain as specified in the IDG.
3. Provide a sense of entry through the use of berming, entry signage, clustering of trees, shrubs and flowers. The entry feature should be located just before the east and west sides of the Access Control Point (ACP).

Shallow depressions will be created to capture some surface water runoff in association with planting new trees.

Provide a sense of entry through the use of berming, entry signage, clustering of trees, shrubs and flowers.

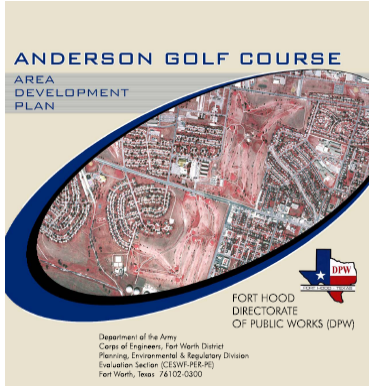
4. Provide directional signage to direct visitors to key areas throughout the installation.

5. Provide a pedestrian pathway from the natural area at the northeast corner of Clear Creek Road and Tank Destroyer Boulevard to the Clear Creek Commissary and the Main Post Exchange. Coordinate pedestrian crossing with Clear Creek Road and Tank Destroyer Boulevard planned intersection improvements that include the following: a) new double left-turn lane on westbound Tank Destroyer Boulevard approach to Clear creek Road, b) new right-turn lane on westbound Tank Destroyer approach to Clear Creek Road, and c) new double left-turn lane on northbound Clear creek Road approach to Tank Destroyer Blvd.

6. Decrease width of the mowed right-of-way to 20 feet. Reintroduce native vegetation outside the 20 foot wide right-of-way.

6.3 PRIORITY IMPROVEMENT PROJECT NO. 3 - FORT HOOD STREET CORRIDOR

Existing Conditions



Fort Hood Street is a secondary entrance to Fort Hood and extends from Highway 190 north to Tank Destroyer Boulevard where it terminates. The State of Texas is funding a large portion of the extension of this roadway north of Tank Destroyer Boulevard to Central Drive. Additional funding is being provided by Fort Hood Family Housing. Roadway construction also includes a new ACP. This roadway extension is being constructed through the former Anderson Golf Course. As part of the roadway expansion efforts and overall redevelopment of the Anderson Golf Course site, an Area Development Plan (ADP) is currently being drafted to guide the overall land development design.

Project / Design Concept Description

1. In conjunction with the ADP, maintain a 100-foot buffer along Fort Hood Street. As with Clear Creek Road (PIP 2), develop a naturalistic landscape treatment through the creation of berms and installation of native Texas Prairie plant communities.

Proposed housing concept plan for northern portion of Anderson Golf Course, by Fort Hood Family Housing.

Proposed housing concept plan for southern portion of Anderson Golf Course, by Fort Hood Family Housing.

Proposed concept plans for the northern and southern portions of Anderson Golf Course.

The lack of poor landscaping and signage regulations have facilitated the negative visual character of Fort Hood Street within the City of Killeen.

2. Within the buffer, construct a recreational trail segment in conjunction with the Fort Hood Greenway program (PIP 23).

3. Along Fort Hood Street, install a continuous row of ornamental street lights. Lamp, standard, and spacing will be consistent with IDG Section 11 recommendations.

4. Along Fort Hood Street, install directional signage of the type and design recommended within the IDG, Section 11.

6.4 PRIORITY IMPROVEMENT PROJECT NO. 4 - MAIN STREET

Existing Conditions

In February 2003, a Main Street Draft Master Plan and Memorial Walk Concept Plan (Main Street Plan) was developed for the 761st Tank Battalion Avenue corridor from 58th Street to 27th Street. This east/west corridor is approximately 1.5 miles long and is located in a highly visible and central portion of the main cantonment area. The plan provides concept design guidelines for land use changes, open space, and street design to include transportation improvements. The underlying concept of the plan is to promote and instill a sense of community at Fort Hood by creating a vibrant commercial and social hub where individuals can gather in a pedestrian-friendly environment.

The above newly constructed building was designed based on the Main Street Draft Master Plan and is located at the southeast corner of 761st Tank Battalion Avenue and Hood Road.

Project / Design Concept Description

The purpose of this PIP is to update the Main Street Plan concept to ensure consistency with other projects/actions that have or are planned to occur, such as support for Army Transformation, recommended intersection improvements at Hood Road and 761st Tank Battalion Avenue, and the updating of the IDG and Real Property Master Plan.

1. Main Street Master Plan proposed land use and overall concept to be validated.

MAIN STREET DRAFT MASTER PLAN

6.5 PRIORITY IMPROVEMENT PROJECT NO. 5 - URBAN NATURAL AREA A

Existing Conditions

This 125-acre parcel is currently a natural area that runs along the east side of Clear Creek Road and buffers the family housing zone from the main cantonment development. Ball fields are adjacent to the northern boundary and some existing trails wind through the site and are fairly well maintained. For the most part, however, this area is in a natural state. An official designation of this area as a natural and cultural area has been approved by the Garrison Commander and was signed 04 January 2001.

Natural Area A.

Project / Design Concept Description

The objectives of this project are to enhance the existing passive recreational benefits, improve accessibility for Fort Hood's residents and visitors, and habitat preservation and enhancement.

The natural recruitment and reintroduction of wildflowers and grasses provide a favorable alternative to mowing grass.

1. Integrate natural area into Fort Hood Greenway (PIP 23).
2. Create a safe pedestrian crossing from Comanche Village II and the Clear Creek Commissary to the natural area.
3. Build upon the existing trail network and improve the existing trail system with signage and maintenance. Incorporate benches and interpretive signage along trail.

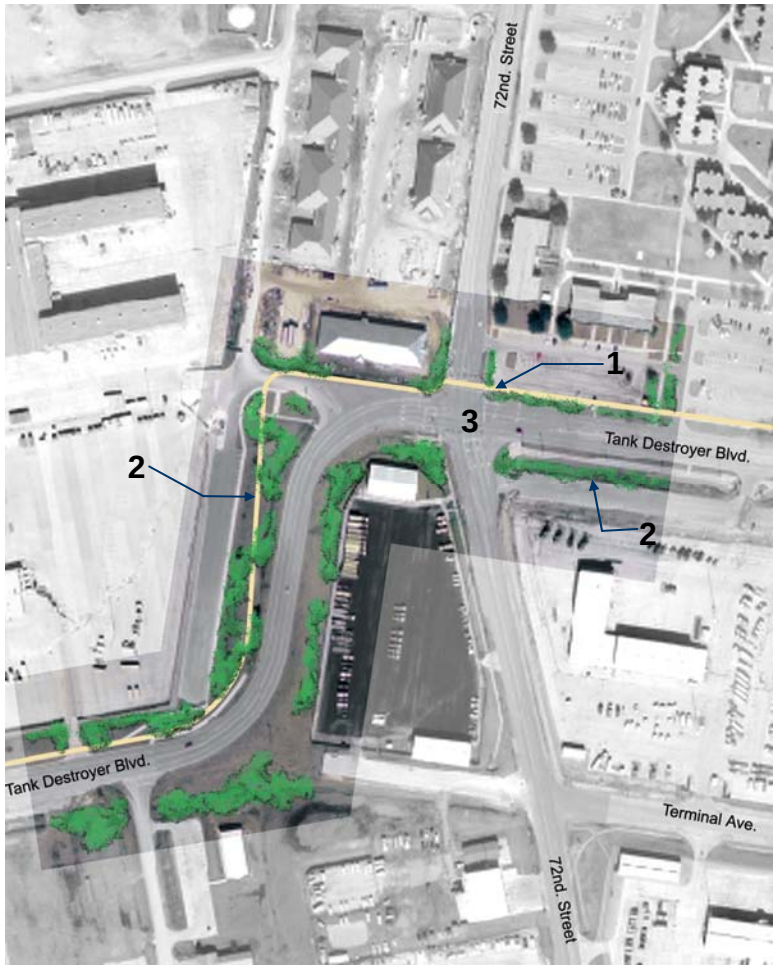
4. Create a number of trailhead areas along the edge of the natural area for visitors. Provide these areas with limited site furnishings and pervious surface parking.

5. Reconfigure drainage culverts and create a dry/wet stormwater retention area.

6. Decrease width of the mowed right-of-way to 20 feet along natural area frontage roads. Reintroduce native vegetation, such as native grasses and wildflowers, outside the 20-foot-wide right-of-way.

7. Create an animal sanctuary and use for educational purposes.

6.6 PRIORITY IMPROVEMENT PROJECT NO. 6 - INTERSECTION IMPROVEMENT, TANK DESTROYER BOULEVARD & 72ND STREET



Existing Conditions

This intersection is fairly well utilized by both pedestrians and vehicles. Pedestrian activity was observed primarily along the north side of Tank Destroyer Boulevard crossing 72nd Street and vehicle traffic seemed fairly heavy in all directions. The vehicle signal lights and signage are in an acceptable condition. There are no pedestrian lights, controls, or crosswalk markings and sidewalk improvements are required. At the northeast corner of the intersection is a surface parking lot in need of screening and at the northwest corner are newly constructed 13th COSCOM-related buildings with some new landscaping installed. A prominent concrete drainage structure is on the south side of the intersection and overhead utility lines run along the south side of Tank Destroyer Boulevard and on the west side of 72nd Street.

The lack of pedestrian signals, limited sidewalks and curb cuts at this intersection provide for an unsafe pedestrian environment.

Trees on each corner, similar to the trees shown above, will, at maturity, provide aesthetic enhancements, habitat value, and shade for pedestrians.

Project / Design Concept Description

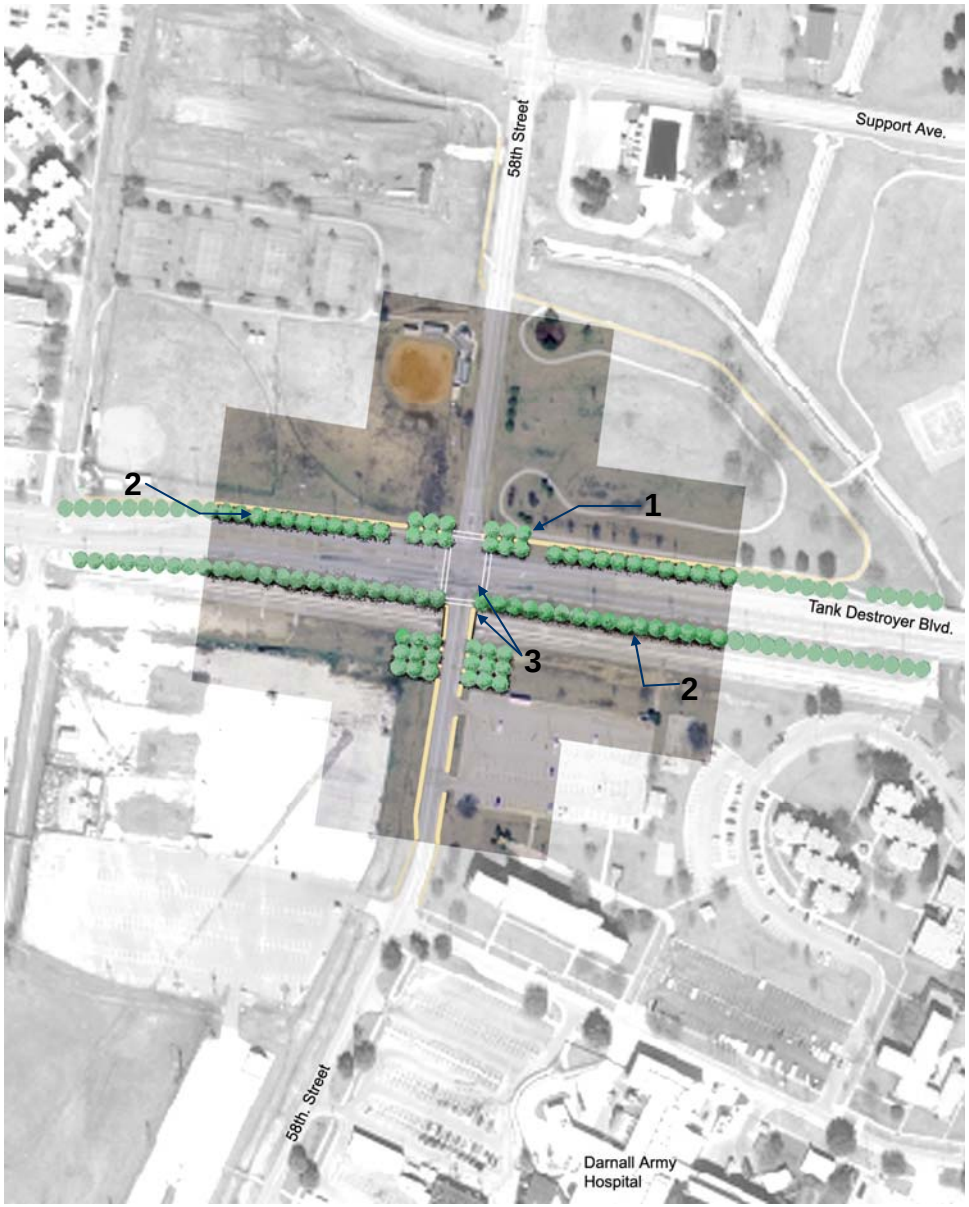
This improvement project should be coordinated with PIP Nos. 11 and 23. The primary objectives of this PIP are to improve pedestrian connectivity and safety and to provide aesthetic enhancements.

1. Install trees and shrubs at each corner to provide aesthetic enhancements. Consider safe sight distances when planting and install and maintain according to IDG.

2. Integrate intersection pedestrian enhancements and landscaping into Tank Destroyer Boulevard Corridor (PIP No. 11) and Fort Hood Greenway (PIP No. 23) improvement projects.

3. Install pedestrian control lights, provide crosswalk markings, and improve sidewalk connectivity.

6.7 PRIORITY IMPROVEMENT PROJECT NO. 7 - INTERSECTION IMPROVEMENT, TANK DESTROYER BOULEVARD & 58TH STREET



Existing Conditions

Reinstall missing railing over the drainage flowway.

Relatively moderate vehicle traffic was noted at this intersection, and the vehicle signal lights and signage are in an acceptable condition. Pedestrian control signals have been installed, but do not operate. This intersection requires new pedestrian crosswalk markings and no railing is currently provided on the portion of sidewalk over the concrete drainage flowway bridge (southeast corner of 58th Street & Tank Destroyer Boulevard). The concrete drainage flowway is along the southern portion of Tank Destroyer Boulevard, as are overhead utility lines.

Project / Design Concept Description

This improvement project should be coordinated with PIP Nos. 11 and 23. The primary objectives of this PIP are to improve pedestrian safety and to provide aesthetic enhancements.

Repair pedestrian signal timing and repaint crosswalk markings.

1. Install trees and shrubs at each corner to provide aesthetic enhancements. Consider safe sight distances when planting and install according to the IDG.

2. Integrate intersection pedestrian enhancements and landscaping into Tank Destroyer Boulevard Corridor (PIP No. 11) and Fort Hood Greenway (PIP No. 23).

3. Fix pedestrian control lights, provide crosswalk markings and improve sidewalk connectivity. Install bridge railing next to sidewalk.

6.8 PRIORITY IMPROVEMENT PROJECT NO. 8 - INTERSECTION IMPROVEMENT, TANK DESTROYER BOULEVARD & 24TH STREET

Existing Conditions

This intersection is located near the east gate and relatively heavy traffic was noted. The vehicle signal lights and signage are in acceptable condition. Some curb cuts have been installed and the crosswalk markings need to be repainted. Pedestrian signals have been provided, however, the length of time given to cross needs to be increased. Overhead utility lines are located along the south side of Tank Destroyer Boulevard and the west side of 24th Street.

Crosswalk markings are missing and the pedestrian signal timing needs to be increased.

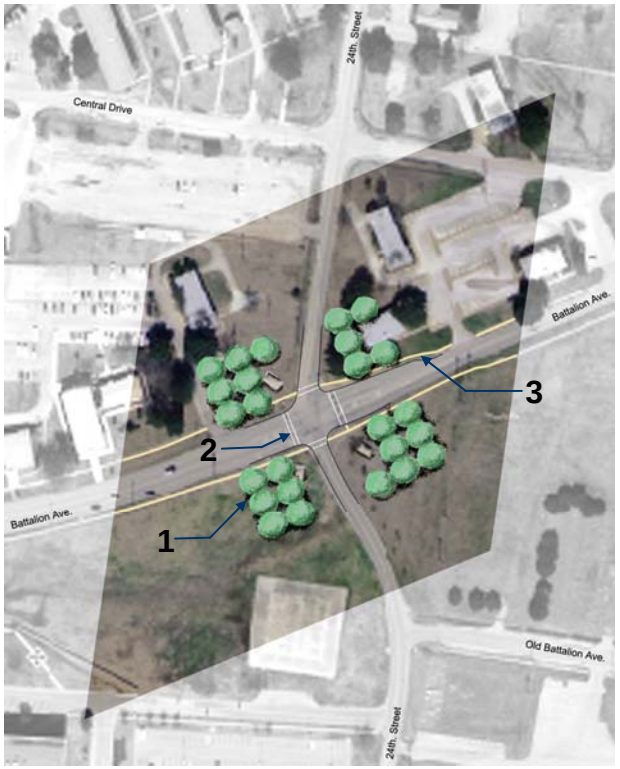
Project / Design Concept Description

This improvement project should be coordinated with PIP No. 11. The primary objectives of this PIP are to improve pedestrian safety and to provide aesthetic enhancements.

The mature shade trees on the southwest corner help conceal the overhead utility lines.

1. Install trees and shrubs at each corner to provide aesthetic enhancements. Consider safe sight distances when planting and install according to the IDG.
2. Integrate intersection pedestrian enhancements and landscaping into Tank Destroyer Boulevard Corridor (PIP No. 11).
3. Coordinate intersection improvements with planned roadway construction that includes a new double left-turn lane on southbound 24th Street at Tank Destroyer Boulevard.
4. Repaint crosswalk markings and increase the duration of the pedestrian signals to allow sufficient time to cross Tank Destroyer Boulevard.

6.9 PRIORITY IMPROVEMENT PROJECT NO. 9 - INTERSECTION IMPROVEMENT, BATTALION AVENUE & 24TH STREET



Existing Conditions

A moderate amount of vehicle traffic was noted and the vehicle signal lights and signage are in acceptable condition. Some pedestrian activity was noted and worn footpaths were visible. There are no pedestrian signals or crosswalks and some portions of the sidewalk are missing. The Ironhorse Parade Field is located at the southwest corner of the intersection. A well-landscaped and visually appealing church is located at the northwest corner. Retired tanks that also add visual character to this intersection have been positioned at the northwest, southwest, and southeast corners.

Project / Design Concept Description

The primary objectives of this PIP are to improve pedestrian safety and to provide aesthetic enhancements.

1. Install trees and shrubs at each corner to provide aesthetic enhancements. Consider safe sight distances when planting and install according to the IDG. Integrate the tanks into the landscape enhancement.
2. Install crosswalk markings and pedestrian signals.
3. Install missing sections of sidewalk in the locations of worn footpaths according to the IDG standard. Ensure safe distances between new sidewalks and traffic

Installed landscaping should not block views of tanks from the street.

Worn footpaths and user observation indicate the need for a sidewalk, as well as a curb cut at this intersection.

6.10 PRIORITY IMPROVEMENT PROJECT NO. 10 - INTERSECTION IMPROVEMENT, 72ND STREET & NORTH AVENUE

Existing Conditions

This intersection is located within the heavy industrialized motor pool area. A moderate amount of vehicle traffic was noted and improved traffic management at this intersection is required. Currently, a one-way stop exists on the 72nd Street side. A moderate amount of pedestrian activity was observed primarily between the parking area at the northeast corner of 72nd Street and North Avenue to the motor pool area just to the south.

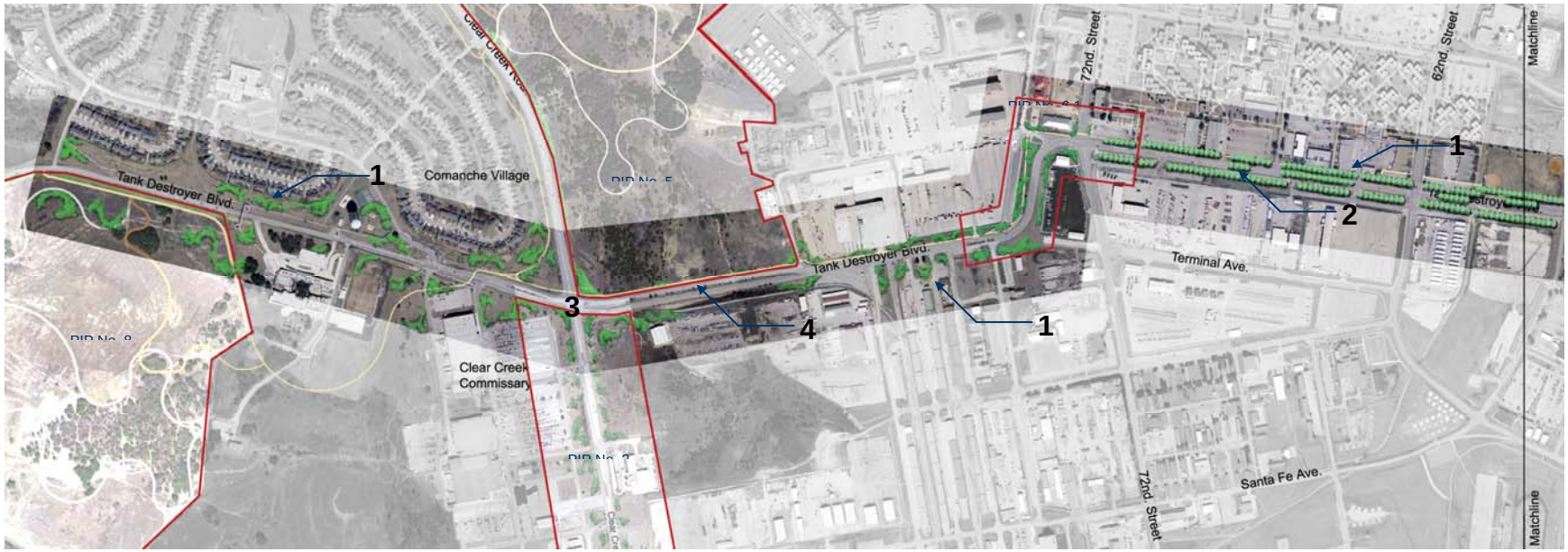
Project / Design Concept Description

The primary objective of this PIP is to improve pedestrian and vehicle safety.

1. Install crosswalks at key locations based on observation of pedestrian movement and worn footpaths.
2. Consider the installation of a stop sign on the North Avenue side, thereby creating a four-way stop at this intersection. This four-way stop would improve both vehicle and pedestrian safety.

Parking occurs along the north side of the road for access to the motor pools to the south. No crosswalks and a one-way stop at this intersection provide an unsafe condition for vehicles and pedestrians

6.11 PRIORITY IMPROVEMENT PROJECT NO. 11 - TANK DESTROYER BOULEVARD CORRIDOR



Existing Conditions

The Tank Destroyer Boulevard Corridor extends from the Comanche Village II on the west to the East Gate. There are a range of land uses along this corridor that include open space natural areas, a motor pool, maintenance and warehousing, administrative, residential, hospital and lodging accommodations. Some landscaping exists that primarily includes shade trees. Where some sections of sidewalks are missing, worn footpaths are visible. Some of the intersections have missing or nonfunctioning pedestrian signals and faded or nonexistent crosswalk markings. Overhead utility lines are prominent and parallel the southern side of Tank Destroyer Boulevard along the entire corridor. A concrete drainage system from 72nd Street east to Wratten Drive is along the south side of Tank Destroyer Boulevard where it then connects with a larger drainage system. A median runs most of the length of Tank Destroyer Boulevard; the median is comprised of a concrete material with the exception of some areas near Clear Creek Road that are grass with some trees. Also within the median, between 72nd Street and 24th Street, are street lights that visually resemble highway or interstate lighting.

Suitable shade trees like those shown in the background above should be continued east of 72nd Street and on the north side of Tank Destroyer Boulevard within the narrow strip of sod shown above.

Project / Design Concept Description

The objectives of this project are to improve the overall visual character of this corridor, enhance pedestrian circulation, and improve directional signage.

1. To create a positive visual impact along this corridor, a significant amount of shade trees should be planted on both the northern and southern sides. Along the southern portion of the corridor, the trees should be installed between the concrete drainage flowway and the edge of the pavement, as appropriate and where feasible. Along the northern side, the trees should be planted between the sidewalk and the edge of the pavement, as appropriate and where feasible. An appropriate tree type should be considered, such as the Plateau Live Oak, which will not interfere with existing utility lines. All landscaping should be installed and maintained according to the IDG. Consideration should be given to installing new trees that are the same as the established shade trees already in place along this corridor.

2. Install suitable shade trees within the median, where feasible, with consideration given to safe sight and not degrading median lighting.

3. Tank Destroyer Boulevard intersection improvements should be considered and coordinated. The various intersection improvements include: a) new double left-turn lane on westbound Tank Destroyer Boulevard approach to Clear Creek Road, b) new right-turn lane westbound Tank Destroyer Boulevard to Clear Creek Road, c) new double left-turn lane on northbound Clear Creek Road approach to Tank Destroyer Boulevard, d) new double right-turn lane on eastbound Tank Destroyer Boulevard approach at Hood Road, e) new double left-turn lane on

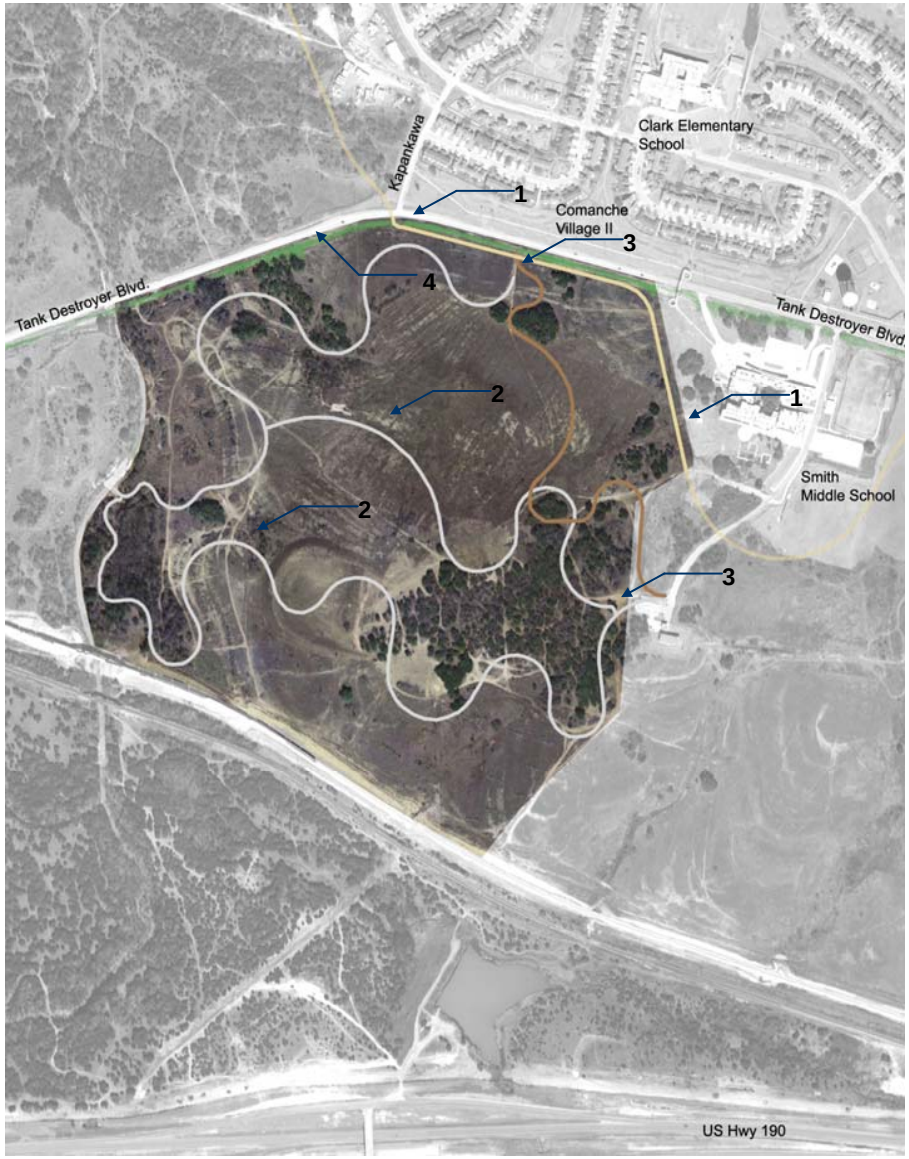
Plant appropriate shade trees that will not interfere with the utility lines between the concrete flowway and the street along the south side of Tank Destroyer Boulevard.

southbound 31st Street approach to Tank Destroyer Boulevard, and f) new double left-turn lane on southbound 24th Street approach to Tank destroyer Boulevard.

4. Install sidewalks, as appropriate, to improve pedestrian safety and connectivity.

5. Coordinate project improvements with Priority Improvement Project Nos. 1 (Hood Road Corridor), 2 (Clear Creek Road Corridor), 5 (Urban Natural Area A), 6.1 (Tank Destroyer Boulevard & 72nd Street), 6.2 (Tank Destroyer Boulevard & 58th Street), 6.3 (Tank Destroyer Boulevard & 24th Street), 8 (Urban Natural Area B), 9 (Hospital Expansion), and 12 (Fort Hood Memorial Park).

6.12 PRIORITY IMPROVEMENT PROJECT NO. 12 - URBAN NATURAL AREA B



Existing Conditions

An example of the type of trail that could be installed within the Natural Area B.

This parcel is currently a natural area that runs along the south side of Tank Destroyer Boulevard, east side of Clear Creek, and west of Smith Middle School. The A.T. & S.F. Railroad is at the southern extent of this area. This site includes a capped landfill and a portion was formerly used for occasional training. Some existing trails wind through the site. An official designation of this area as a natural and cultural area has been approved by the Garrison Commander and was signed 04 January 2001.

Project / Design Concept Description

The objectives of this project are to enhance the existing passive recreational benefits, improve accessibility for Fort Hood's residents and visitors, and habitat preservation and enhancement.

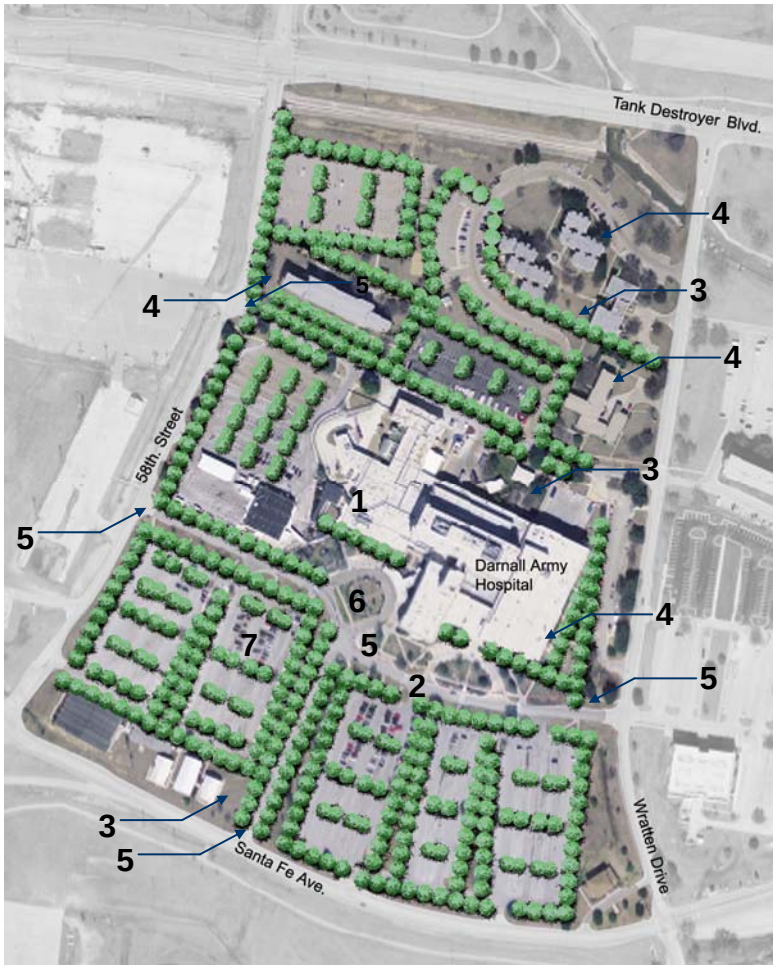
1. Integrate the natural area into Tank Destroyer Boulevard Corridor (PIP No. 11) and Fort Hood Greenway (PIP No. 23).

2. Build upon the existing trail network and improve the existing trail system with signage and maintenance. Incorporate benches and interpretive signage along the trail. Consider Smith Middle School student involvement in the process.

3. Create a number of trailhead areas along the edge of the natural area for visitors. Provide these areas with limited site furnishings and pervious surface parking.

4. Decrease width of the mowed right-of-way to 20 feet along Tank Destroyer Boulevard. Reintroduce native vegetation, such as native grasses and wildflowers, outside the 20-foot-wide right-of-way.

6.13 PRIORITY IMPROVEMENT PROJECT NO. 13 - HOSPITAL EXPANSION



Existing Conditions

This improvement project encompasses the Darnall Army Community Hospital and associated Medical Department Activity (MEDDAC) uses located near the Main Gate, west of Wratten Drive and the north side of Santa Fe Avenue. MEDDAC provides complete healthcare to Fort Hood military personnel and their families, as well as to retirees. Based on current and expected future demand, a number of expansion projects are either planned, under construction, or just recently completed. The west side of Darnall Army Community Hospital is undergoing a two-story, 34,000-square-foot addition. The current condition of the area under renovation includes a temporary facility for the emergency room, as well as borrowed land for additional surface parking. This arrangement has led to an unsafe pedestrian environment. The Darnell Counseling Center is undergoing an expansion and renovation to convert the facility to mental health services. The Moore Health Clinic, Blood Bank, and Social Services is a newer development that clusters these three facilities together and the site amenities need improvement.

These pictures illustrate the need for pedestrian improvements, such as crosswalks and sidewalks at key locations within the hospital complex.

Project / Design Concept Description

1. Complete a parking study to evaluate parking space deficiencies and determine recommended actions, such as the feasibility of a parking deck.
2. Install pedestrian safety measures (lights, crosswalks, and signage) and coordinate with the recommended improvements identified by the parking study.
3. Install a pavilion 50 feet from key building entries with landscaping.

The installation of trees and shrubs, as specified in the IDG, would greatly enhance the overall visual character of this area, as well as provide much needed shade from the harsh summer heat.

4. Install building foundation landscaping as well as landscaping along pedestrian and vehicle pathways to enhance the overall visual image and to provide relief from the harsh summer sun.

5. Provide clear building and circulation signage to improve wayfinding.

6. Install sidewalks for improved pedestrian connectivity to parking areas and adjacent buildings. Provide benches along pedestrian paths in areas that currently provide shade. This improvement should be coordinated with PIP Nos. 1 (Hood Road Corridor) and 2 (Clear Creek Road Corridor).

7. Continue the use of solar power for parking lot and other exterior lighting.

6.14 PRIORITY IMPROVEMENT PROJECT NO. 14 - BATTALION AVENUE CORRIDOR

This type of landscape edging is to be avoided. All landscape edging should follow the Landscape Design Standards identified in Chapter 10 of this IDG.

Existing Conditions

The portion of Battalion Avenue included within this PIP is a two-lane, two-way corridor bounded on the west by Clear Creek Road and on the east by Hood Drive. Buildings of varying sizes and densities flank both sides of Battalion Avenue. Troop housing barracks are to the north. These buildings are high-density, multiple-story structures, set back some distance from the road, and maintain large, gently-sloping, formal lawn spaces. Interspersed between troop housing are several smaller, modest buildings, situated a minimal distance off the road's edge, with parking lots either to the side or behind the buildings. Company operations and other administrative support occupy these buildings.

Battalion Avenue cuts across the south-facing slope upon which the cantonment is built. There is a modest increase in elevation north of Battalion Avenue, while the lands to the south slope away from the road. For buildings situated close to the road's northern edge, the approximately 2-foot elevation change is quite noticeable. Most division headquarters buildings maintain a short flight of stairs to negotiate the grade break between the sidewalk along the road to an upper terrace and building entrance. The upper terraces of these buildings contain an ad hoc variety of plantings, edge and bed treatments, paving materials and finishes. Landscape modifications are random, residential in character, and appear to have taken place over several timeframes. In several cases, pedestrian circulation does not conform to Americans with Disabilities (ADA) or American Association of State Highway and

Transportation Officials (AASHTO) standards. Stairs and sidewalks are randomly placed, are of varying construction qualities and finishes, and do not resonate with an overarching circulation network. There is no continuity of treatment between one building and the next.

Project / Design Concept Description

To engender a sense of formality and order characteristic of the military paradigm, the front yards of all division headquarters and other administrative support buildings along the north side of Battalion Avenue will be redesigned in accordance with a master plan and limited palette of building and plant materials. The following improvements will be incorporated along the length of Battalion Avenue from Clear Creek Road to Hood Drive.

This sidewalk is too narrow and does not appear to conform to ADA or AASHTO standards.

1. To provide greater security and a sense of continuity, construct a low (18 to 24 inches high), masonry retaining wall along the north edge of the sidewalk only on the north side of Battalion Avenue from 53rd Street to 67th Street. A uniform stair and railing treatment will interrupt the wall at the location of building entrances.

This wall is an example of one type of masonry retaining wall to be installed along the edge of the sidewalk on the north side of Battalion Avenue from 53rd Street to 67th Street. The retaining wall will provide greater security and a sense of continuity.

2. Maintain a continuous rhythm of Texas white ash street tree plantings, 30 feet on center, in front of buildings that are in close proximity to the roadway. Do not interrupt large open spaces with street tree plantings.

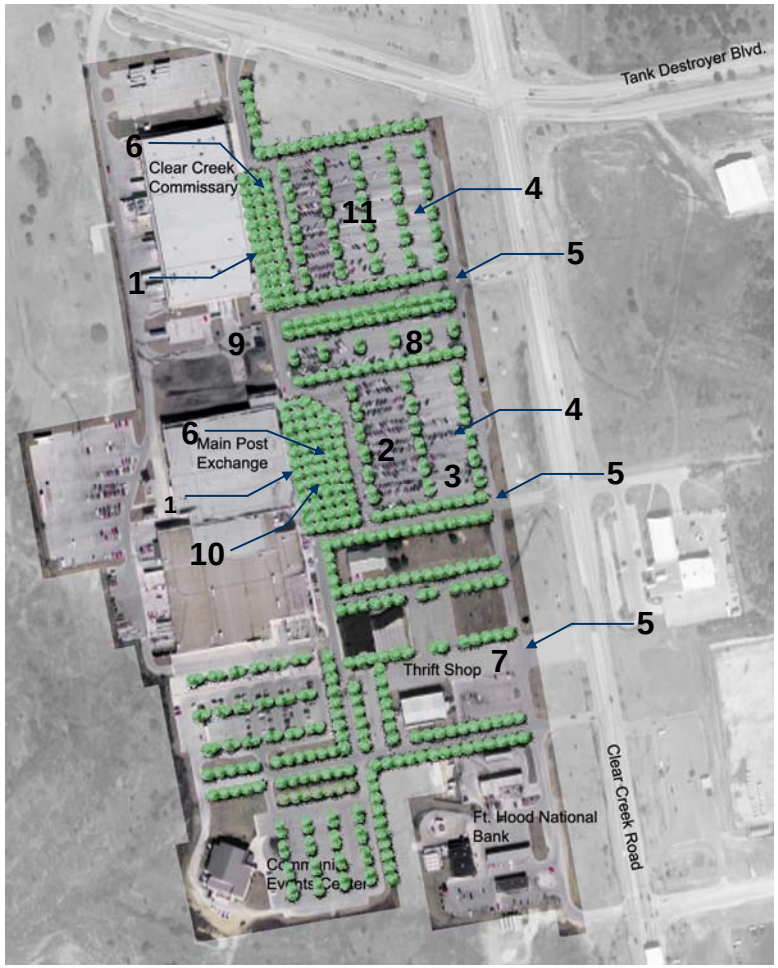
3. Foundation plantings and installations will be in accordance with IDG Section 10 and will bear some relationship to the building façade and circulation patterns, and will meet force protection requirements.

4. A primary sidewalk will run from the main sidewalk along Battalion Avenue to the main building entrance. Secondary sidewalks will connect parking lots to the primary sidewalk. Align secondary sidewalks to be parallel with Battalion Avenue.

5. Bed edging will be steel landscape edging, in conformance to edging recommendations found within IDG Section 10.

6. Mulch will be shredded hardwood mulch, uniform in color and size, throughout beds within the area of Battalion Avenue.

6.15 PRIORITY IMPROVEMENT PROJECT NO. 15 - CLEAR CREEK COMMISSARY AND MAIN POST EXCHANGE



Existing Conditions

The Clear Creek Commissary and Main Post Exchange are located along the western edge of Clear Creek Road just inside the ACP from Highway 190. The style of the development is suburban in character and suffers from the typical suburban development issues, such as lack of connectivity between buildings, vast areas of asphalt parking lots without shade, lack of pedestrian walkways, entryways void of landscape, random signage, and an overall lack of visual character. Recent heightened measures in force protection that mandate restriction of vehicular access in proximity to building entryways has resulted in the use of low barriers. These force protection measures have led to a huge open zone at the front entrance of the buildings. Attempts have been made to fill this space with vending booths and benches under trees and around planters; however, the effect is less than desirable and the climate in these spaces is extremely hot.

Force protection zones, like the one illustrated above, should be enhanced with planters, benches, and pedestrian pathways. Consideration should be given to providing space for outside vendors.

Project / Design Concept Description

1. Enhance the building entries with planters, trees, benches, and colorful banners.

2. Integrate pedestrian walkways and landscaping into the parking lot by reorganizing the parking layout and removing sections of the asphalt for tree islands. Use pervious paving around trees to increase the amount of water to the plants.

3. Include a sustainable stormwater management plan that retains and improves the water quality of stormwater runoff from the parking lot.

4. Remove the portion of the parking lot that receive only high peak usage and replace with pervious materials.

5. Enhance the entry roads with planted medians. Currently, they are excessively wide and either could be narrowed or center islands could be incorporated.

6. Provide for pedestrian gathering areas and plenty of shade.

7. Improve the signage and wayfinding system.

8. Consider infilling the existing development with new development that clusters the buildings together and creates a pedestrian promenade.

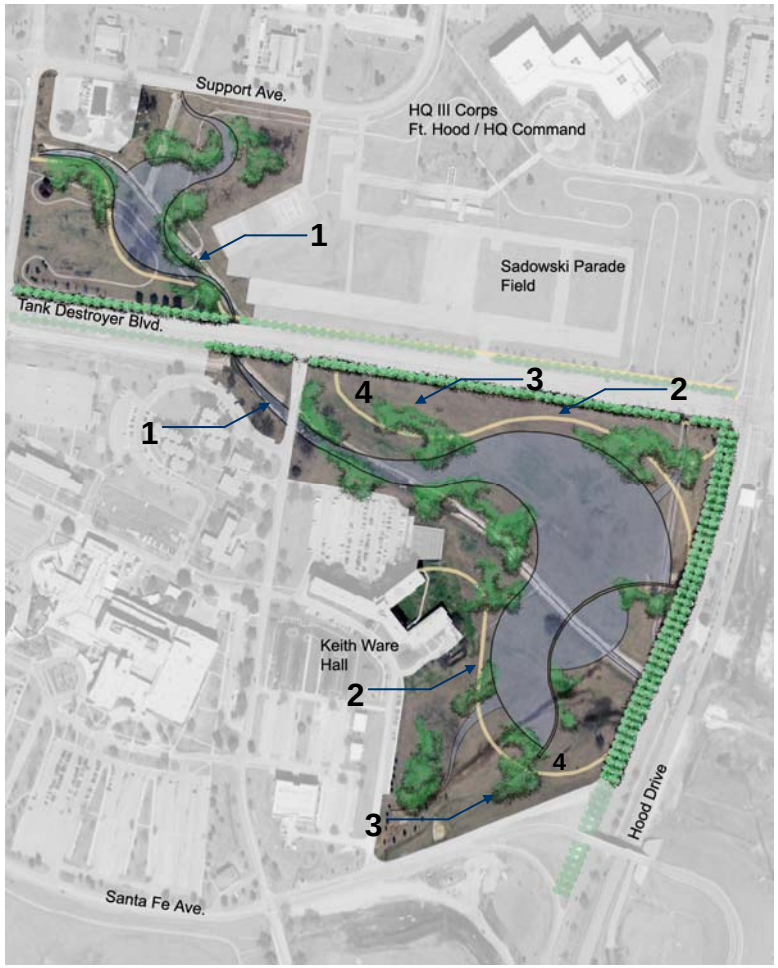
9. Screen all dumpsters.

10. Modify the existing force protection wall to be aesthetically pleasing and incorporate trees and seating into the wall.

11. Replace parking lighting with solar power lights.

Additional tree islands should be considered throughout all surface parking areas.

6.16 PRIORITY IMPROVEMENT PROJECT NO. 16 - FORT HOOD PARK



Existing Conditions

Replacement of the existing concrete flowway would provide multiple benefits, such as improved water quality downstream, recreational amenity, as well as an aesthetic enhancement.

Upon entering the main gate on Fort Hood Road, a large, slightly sloping open area flanks the corridor's western edge. This open space area is defined by Tank Destroyer Boulevard to the north and Keith Ware Hall to the west. Beyond Tank Destroyer Boulevard are the Sadowsky Parade Field and the HQ III Corps Fort Hood / HQ Command Center. The open space is devoid of trees and bisected by a very large, concrete drainage flowway. This flowway drains much of the cantonment area. The open space follows the flowway north of Tank Destroyer Boulevard to the west of the parade field.

Project / Design Concept Description

Because this is a high visibility area, both for people arriving to the installation as well as for military command, there is an opportunity to develop a passive recreational amenity for Fort Hood residents, as well as for visitors staying at Keith Ware Hall. This park could commemorate the mission and recent activities of those posted at Fort Hood. Instead of a single statue, the entire landscape could be designed as a memorial to those who have made the ultimate sacrifice for their country.

1. Remove the concrete flowway and widen the cross-section of the drainage corridor so it is much wider and shallower. Regrade the site so the drainage corridor meanders. Through the use of low retaining walls and weirs, retain stormwater and create a large water feature. Based on water levels in the retention area, an active water element, such as a single water spout or series of smaller jets may be possible.

2. To provide access to the park and water feature, install a recreational trail. This trail would connect to the larger Fort Hood Greenway discussed in PIP No. 23.

3. Plant groves of trees around the water feature to provide shade. Add benches and picnic tables for people visiting the park.

4. At a key gathering place off the recreational trail, provide interpretive signage describing the significance of the park.

6.17 PRIORITY IMPROVEMENT PROJECT NO. 17 - CENTRAL SHOP AREA

Existing Conditions

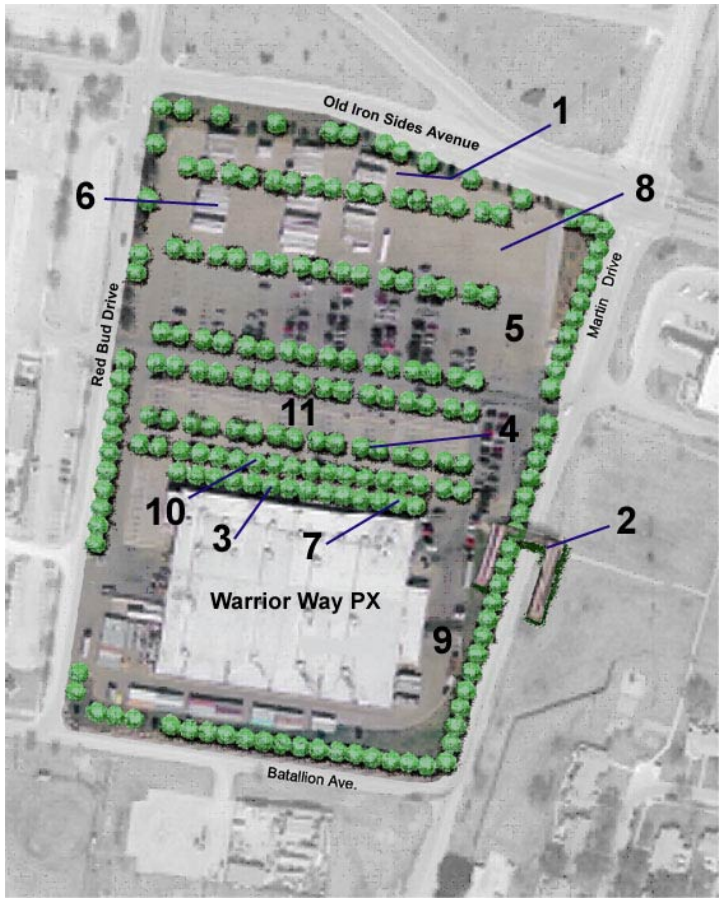
This area is located in the heart of the main cantonment area to the south of 761st Tank Battalion Avenue near the intersection of Hood Road. It is immediately adjacent to the new "Main Street" food court development, which utilized better development principles than seen previously in commercial-type development on the Installation.

Project / Design Concept Description

1. Replace all the existing site furnishings with new site furnishings that incorporate shade.
2. Reorganize the parking lot layout by improving the entry landscaping, removing the one-way drives, and incorporating shade trees into the parking areas.
3. Clean up the service dock areas behind the buildings.
4. Create a pedestrian connection between the adjacent housing developments and the commercial area.
5. Connect the lower and upper parking lots with sidewalks and stairs.
6. Improve and update the facades and exteriors of the buildings.
7. Consider converting the green parcel in the middle of the development into a park with seating.
8. Screen all dumpsters.
9. Relocate or better identify the U-Haul business.

The above pictures provide good examples of parking lot landscaping at "Main Street."

6.18 PRIORITY IMPROVEMENT PROJECT NO. 18 - WARRIOR WAY PX



Existing Conditions

The Warrior Way PX is located along the west side of Martin Road and south of Old Iron Sides Avenue. This development and the challenges related to it are similar to Clear Creek Commissary. The challenges include: vast areas of asphalt parking without shade, lack of pedestrian walkways, entryways void of landscape, and an overall lack of visual character. Recent heightened measures in force protection have mandated the restriction of vehicle access in proximity to building entryways, resulted in the use of permanent barriers and large rectangular blocks of stone being used to block vehicular access. These force protection measures have led to a huge open zone of "dead space" at the building's front entrance.

The force protection zone should receive a number of improvements including shade trees and seating around pedestrian pathways. Consideration should be given to providing space for outside vendors.

The trailer storage area currently within the parking area along Old Iron Sides Avenue should be moved to a more suitable location.

Project / Design Concept Description

1. Relocate the trailer storage or create screening to mitigate the view.
2. Relocate the pedestrian bridge over Martin Road from this development to another development which has a higher volume of pedestrian traffic.
3. Enhance the building entries with planters, benches, and colorful banners.

The pedestrian bridge across Martin Drive should be moved to a more suitable location that has a higher volume of pedestrian traffic.

4. Integrate pedestrian walkways and landscaping into the parking lot by reorganizing the parking layout and removing sections of the asphalt for tree islands. Pervious paving could be utilized around trees to increase the amount of water to the plants.

5. Include a sustainable stormwater management plan that retains and improves the water quality of stormwater runoff from the parking lot.

6. Remove the portion of the parking lot that is only utilized during high peak usage and replace with pervious materials.

7. Provide for pedestrian gathering areas and plenty of shade.

8. Consider infilling the unused parking area along Old Iron Sides Avenue with new development.

9. Screen all dumpsters.

10. Incorporate trees and seating within the force protection zone.

11. Replace parking lighting with solar power lights.

12. Improve and update the facades and exteriors of the building.

Tree islands, as pictured above, should be installed throughout the parking area and within the force protection zone.

6.19 PRIORITY IMPROVEMENT PROJECT NO. 19 - EQUIPMENT WASHDOWN IMPROVEMENTS

Existing Conditions

Although the central vehicle wash facilities and oil / water separators associated with the motor pools have contributed to reducing the quantity of pollutants that reach the natural drainage corridors, their design could be improved to allow a more efficient maintenance process, as well as to increase the water quality benefits. Approximately 117 10-by-10-foot oil / water separators are in use in the motor pools and other areas. Many of these separators are operated under a TPDES Wastewater Permit and discharge to detention ponds and then to the environment through permitted outfalls. The discharge routes to the detention ponds use the municipal storm sewer system after the wastewater exits the oil / water separators, but there are no physical barriers in place to keep stormwater runoff from the motor pools from entering the many of these separators. When it rains, stormwater runoff flows off the motor pools and into the oil / water separators, causing the system to overload and overflow. The oil flows over the weirs, through the open drainage channels and into the stormwater detention basins.

To clean a single oil / water separator, it takes three staff members, with three trucks, approximately eight hours. First, one must siphon off the oil and take it to be recycled. Then the water must be drained off to permit access to the deposited sediment. Then the sediment must be cleaned out and taken to a separate facility to be cleaned. Cleaning operations must occur on a routine basis for the whole system to be effective. Currently, the staffing for such maintenance operations is not in place.

Project / Design Concept Description

1. To prevent stormwater runoff from entering the oil / water separators, construct a combination of trench drains and small berms around the oil / water separators. The trench drains will collect and channel stormwater around the separators. Small berms, no more than 6 inches in height, comparable to a speed bump, and easily negotiable in a vehicle, will direct water back into the trench drains, away from the oil / water separators.

2. Develop and institutionalize a routine Oil / Water Separator Maintenance Program. A competent, full-time staff will have dedicated cleaning vehicles and equipment to efficiently dispose of trapped solids and liquids.

6.20 PRIORITY IMPROVEMENT PROJECT NO. 20 - RECREATIONAL IMPROVEMENTS

Existing Conditions

Numerous small playgrounds and outdoor areas consisting of benches, tables and barbecue grills are throughout the main cantonment area, north and west Fort Hood. A few of these recreational features have been updated; however, in large part, most require updating and also lack adequate shade from trees and other covering.

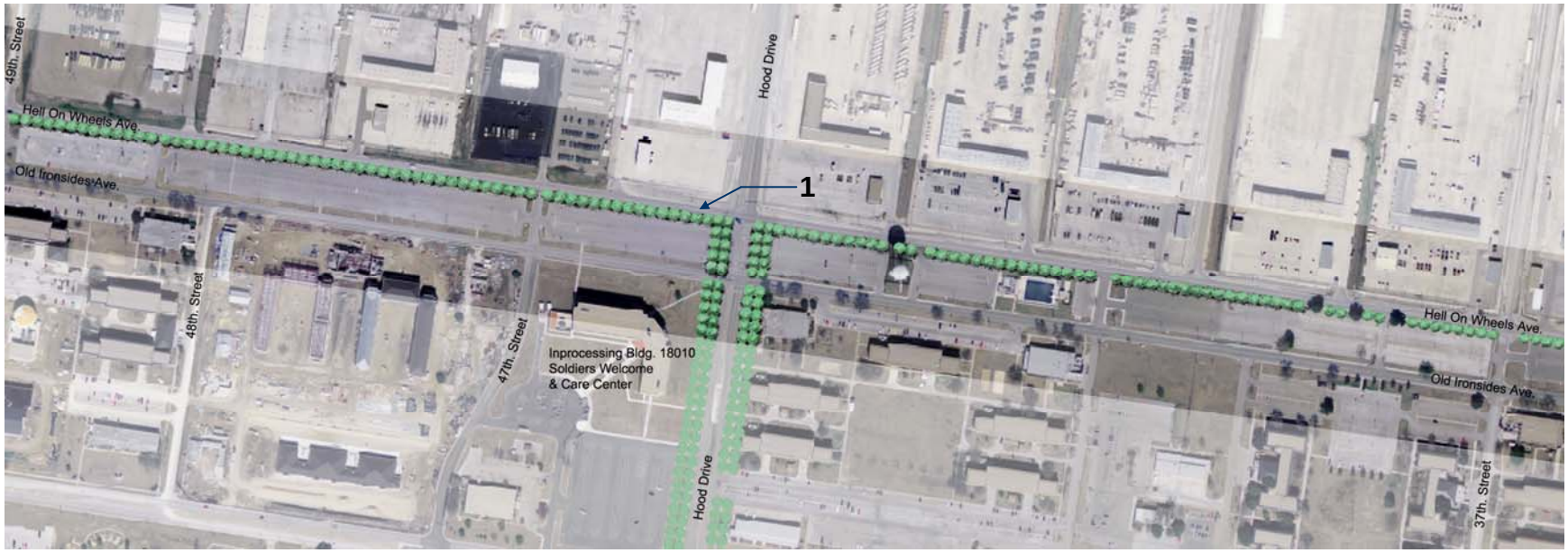
Project / Design Concept Description

1. Update all playground equipment and related areas to improve safety, provide shade, and provide user enhancement. Playground equipment and related areas should meet safety requirements identified by the National Program for Playground Safety.

2. Update all benches, picnic tables, and barbecue grills with modern equipment. Some of these recreational features should be positioned in relative close proximity to playground equipment and along pedestrian pathways, such as those provided in PIP Nos. 5, 12, 16, and 23. For example, within PIP Nos. 5 and 12, there are various pedestrian pathways. In select areas along these pathways, benches and picnic tables could be located.

Note: RCI has allocated funding for updating playgrounds within the family housing areas. This PIP applies only to those areas outside family housing.

6.21 PRIORITY IMPROVEMENT PROJECT NO. 21 - HELL ON WHEELS CORRIDOR



Existing Conditions

Hell on Wheels Avenue is a wide, two-lane, one-way (east to west) corridor. This avenue is one of two corridors that separate the motor pools (Maintenance and Warehousing Visual Zone) to the north, from the troop housing (Troop Housing and Support Visual Zone) to the south. Old Ironsides Avenue is the second corridor and is also a two-lane, one-way corridor (east to west). Parking is provided between these two corridors for those accessing the troop housing and motor pools areas. The northern edge of Hell on Wheels Avenue consists of a drainage swale and gravel groundcover. Along the southern edge of the road, a narrow strip of grass separates the parking lot from the road. There are no trees on either side of the road. Hell on Wheels Avenue is principally used for those accessing the motor pools and parking areas to the south. Additionally, the corridor is the principal route taken when visitors are provided with a tour of the installation.

Install Plateau live oak trees and wax myrtle bushes, or similar landscape material, within the strip of grass along Hell on Wheels Avenue.

Project / Design Concept Description

1. A row of Plateau live oak trees, 30 feet on center, 10 feet off the southern edge of the avenue should be installed to orient and direct views to the north toward the motor pool areas, as well as to visually screen and provide shade for a portion of the parking areas on the southern side of the avenue. Immediately north of the parking lots, plant a row of wax myrtle bushes, 8 feet on center, approximately 6 feet off the edge of the parking lot. Although the above graphic only illustrates planting from 49th Street to 37th Street, the row of trees and shrubs should extend the full length of Hell on Wheels Avenue, from Martin Drive westward to Clear Creek Road.

6.22 PRIORITY IMPROVEMENT PROJECT NO. 22 - PARKING LOT SOLAR SYSTEM

Existing Conditions

Parking lot solar systems generate on-site electric power, reduce energy costs, shaded parking, and reduce the "heat island" effect. Between the main cantonment area, North Fort Hood and West Fort Hood, there are a vast number of surface parking lots where multiple parking lot solar systems could be utilized to offset utility costs.

Project / Design Concept Description

The intent of this improvement project is to recommend that a parking lot solar system be considered at Fort Hood.

Source: NREL, Photographic Information Exchange, Kyocera

The surface parking solar system at the Cal Expo in Sacramento, California, produces enough energy to power about 180 homes.

Surface parking solar system at Austin Energy.
Source: NREL, Photographic Information Exchange, Applied Power Corporation.

1. Install a parking lot solar system within the surface parking lot between the motor pools and troop housing areas.

6.23 PRIORITY IMPROVEMENT PROJECT NO. 23 - FORT HOOD GREENWAY

Existing Conditions

Currently, no coherent pedestrian circulation network exists within the Main Cantonment area. There are limited segments of sidewalk in open space areas, but very little connectivity between these segments. There are no bicycle trails, nor striping for bicycle rights-of-way on existing roads. The only safe mode of travel within the Main Cantonment area is by vehicle.

Project / Design Concept Description

A comprehensive pedestrian circulation system is proposed for the Main Cantonment area. Designed for walking and bicycling, the trail system would weave through existing open space areas, along drainage corridors, and in some cases, parallel roadways; and would link residential neighborhoods with division headquarters, commissaries, recreational facilities, semi-wilderness areas, and maintenance and warehousing facilities. The trail system would be utilitarian and efficient, but also recreational in nature. The trail could be constructed of a range of paving materials, including concrete, asphalt, and compacted reconstituted granite gravel. The trail would be a 10-foot wide multipurpose trail that could accommodate both pedestrian and bicycle traffic and would be constructed to American Association of State Highway and Transportation Officials, Americans with Disabilities Act

(ADA), and Texas Department of Transportation / Federal Highway Administration standards. Where necessary, trees and furnishings such as bicycle racks, lighting, striping and signage also would be associated with the trail.

The Fort Hood Greenway Program could be designed and constructed in several discrete phases. One large trail loop is proposed with potentially several smaller loops and spurs. The Greenway program will provide a safe, sustainable, and healthy alternative to driving within the Fort Hood Main Cantonment area. The proposed greenway trial is shown in yellow.

6.24 PRIORITY IMPROVEMENT PROJECTS LIST

Table 6-1: Priority Improvement Projects List

PRIORITY NO.	PROJECT TITLE	RECOMMENDED FUNDING SOURCE	ALTERNATIVE FUNDING SOURCE	COST ESTIMATE	IDG PARA NO.
1	Hood Road Corridor	Operations and Maintenance, Army (OMA)	Military Construction, Army (MCA)	$413,332	6.1
2	Clear Creek Road Corridor	OMA	MCA	$221,250	6.2
3	Fort Hood Street Corridor	OMA	MCA	$93,750	6.3
4	Main Street	OMA	MCA	$50,000	6.4
5	Urban Natural Area A	OMA	MCA	$406,250	6.5
6	Intersection Improvement, Tank Destroyer Boulevard & 72nd Street	OMA	MCA	$87,500	6.6
7	Intersection Improvement, Tank Destroyer Boulevard & 58th Street	OMA	MCA	$32,500	6.7
8	Intersection Improvements, Tank Destroyer Boulevard & 24th Street	OMA	MCA	$33,750	6.8
9	Intersection Improvement, Battalion Avenue & 24th Street	OMA	MCA	$27,187	6.9
10	Intersection Improvement, 72nd Street & North Avenue	OMA	MCA	$4,375	6.10
11	Tank Destroyer Boulevard Corridor	OMA	MCA	$580,187	6.11
12	Urban Natural Area B	OMA	MCA	$390,625	6.12
13	Hospital Expansion	OMA	MCA	$693,125	6.13
14	Battalion Avenue Corridor	OMA	MCA	$1,129,437	6.14
15	Clear Creek Commissary and Main Post Exchange	OMA	MCA	$1,479,375	6.15
16	Fort Hood Park	OMA	MCA	$2,500,000	6.16

Table 6-1: Priority Improvement Projects List					
PRIORITY NO.	PROJECT TITLE	RECOMMENDED FUNDING SOURCE	ALTERNATIVE FUNDING SOURCE	COST ESTIMATE	IDG PARA NO.
17	Central Shop Area	OMA	MCA	$424,062	6.17
18	Warrior Way PX	OMA	MCA	$558,750	6.18
19	Equipment Washdown Improvements	OMA	MCA	$633,750	6.19
20	Recreational Improvements	OMA	MCA	$341,250	6.20
21	Hell On Wheels Corridor	OMA	MCA	$537,500	6.21
22	Parking Lot Solar System	OMA	MCA	$2,500,000	6.22
23	Fort Hood Greenway	OMA	MCA	$1,520,000	6.23

Site planning is the process of arranging features on the landscape, in the form of structures, paths, edges and spaces, in complete detail, to develop a site or project that: fulfills facility and mission requirements, meets user needs and maximizes benefits to site occupants, creates an optimal relationship with the built and natural environments, provides energy-saving opportunities and integrates the fundamental principles of sustainable design and development throughout.

Building locations, massing, and site orientations do not occur by themselves, but are a product of decision-making. Decisions made during site selection and site planning stages impact natural resources, integration of architectural design, energy performance mission readiness, and site users. The site planning design standards discussed in this section provide decision-making guidance for site selection and planning at Fort Hood. These design standards, when applied, will result in a project that fulfills mission and user requirements and creates the optimal relationship with the natural site.

See UFC 3-210-06A, *Design: Site Planning and Design* for detailed guidance on site planning to include program analysis, site analysis, site verification, and concept development. This UFC also discusses site design guidelines, describes the steps in the site planning process, and contains examples of various sketches/diagrams developed in support of these steps.

Basic Site Design Principles

1. **Habitability.** How well the site supports and meets the mission and user needs.
2. **Sense of Place.** Simplified, sense of place is the "look and feel" of a place or setting. Places at Fort Hood should have a clear perceptual identity: be recognizable, memorable, vivid, and engaging of our attention.
3. **Fit.** The site should make a good fit with the mission and with user actions. This not only applies to work-related tasks, but also adequate parking, quality exterior work-break area, resource conservation, good access, etc.
4. **Access.** The site should be logically and safely connected to other activities or sites. All building sites at Fort Hood should be tailored, not only to cars, but also to bicycles and pedestrians, as well whereby conflicts between them are minimal.

Also see Technical Instruction (TI) 800-01, *Design Criteria,* Chapter 3, “Site Planning and Design Criteria.” Environmental documentation will be prepared prior to site selection to support the construction activity in accordance with AR 200-2, *Environmental Effects of Army Actions*.

The site planning component provides the spatial arrangement of the installation. The installation master plan provides information that forms the foundation for site planning. The master plan is a mechanism for ensuring that individual projects are sited to meet overall installation mission requirements. AR 210-20, *Master Planning for Army Installations* provides additional information concerning the master plan.

The other five design components of the IDG are dependent upon site planning for their location and spatial relationships. These five components are identified below and discussed in Sections 8 through 12:

- Section 8 - Buildings Design Standards;
- Section 9 - Circulation Design Standards;
- Section 10 - Landscape Design Standards;
- Section 11 - Site Elements Design Standards; and
- Section 12 - Force Protection Design Standards.

7.1 SITE PLANNING

The desired end state of site planning for the installation is to produce an attractive, sustainable development that enhances mission readiness. Sustainability requires the built environment to be designed and constructed to protect and enhance the natural environment. General site planning techniques resulting in sustainable development are cost efficient because they conserve energy and reduce construction and maintenance costs. Site planning objectives for Fort Hood include the following:

> "Making places that fit human purposes is the task of site planning."
>
> **Kevin Lynch**

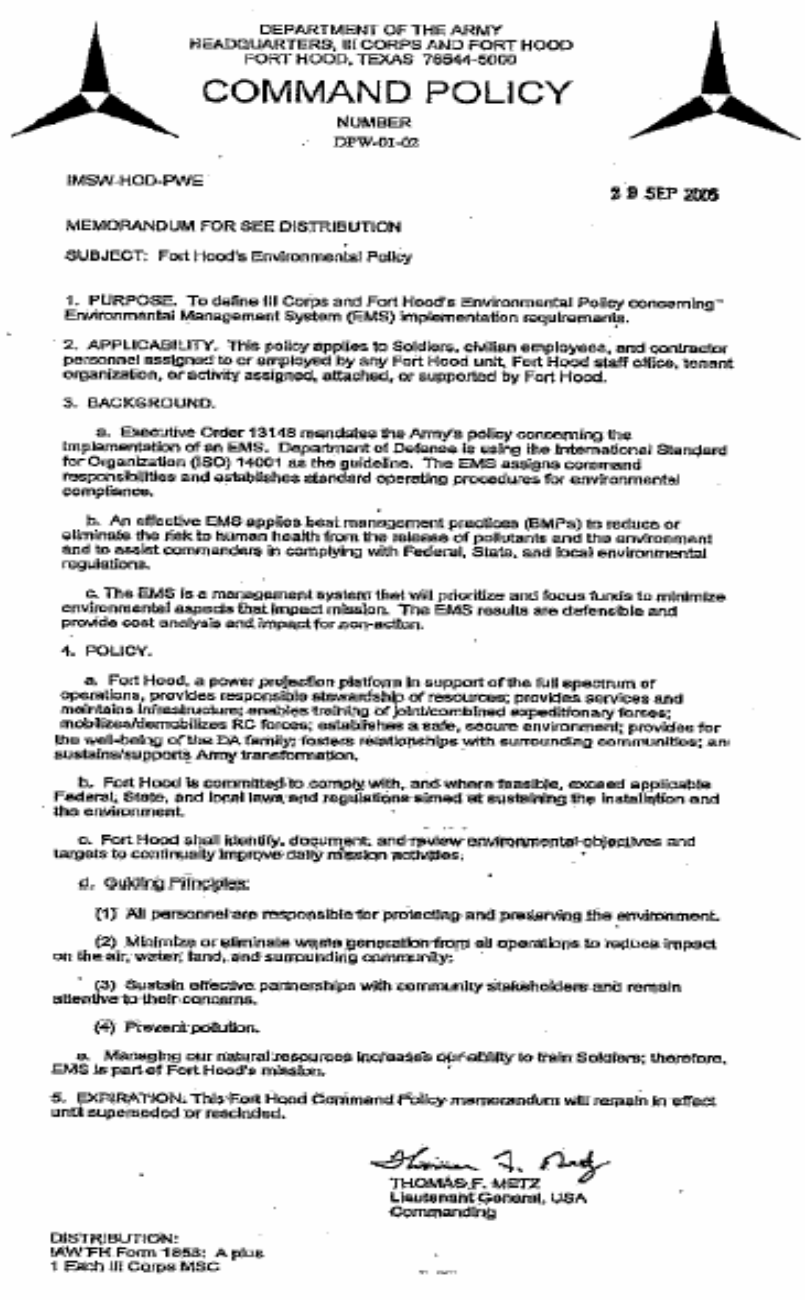
- Protect natural site features such as topography, geological, hydrology, natural views, cultural landscape, and vegetation;
- Plan for the integration of site features that promote sustainable development practices;
- Plan for force protection/security and accessibility measures; and
- Ensure mission and user requirements for the action are met.

7.2 SITE PLANNING: ENVIRONMENTAL CONSIDERATIONS

Environmental issues to consider during site planning include those actions or proposals that may have detrimental effect on a site area's land, water, air, or human resources. To help understand potential environmental impacts before a project is actually constructed, Fort Hood requires, as part of their Environmental Management System (EMS) procedures, an environmental aspect/impact analysis for each project. All questions regarding the EMS should be directed to DPW Environmental: (254) 288-5256. In addition, all National Environmental Policy Act (NEPA) documentation should be started before the site selection process, as this process feeds the 1391 charrette process (see Section 2.3.4).

The potential for the project action to impact a water-related resource must also be considered. This may require a special permit, which is discussed below.

These environmental considerations, as discussed in greater detail below, should be reviewed by the site planner. The site planner must understand that by avoiding, to the maximum extent practicable, the siting of projects in environmentally sensitive areas, it is possible to reduce the amount of regulatory environmental work that must be completed (e.g., the need for permitting).



DEPARTMENT OF THE ARMY
HEADQUARTERS, III CORPS AND FORT HOOD
FORT HOOD, TEXAS 76544-5000

COMMAND POLICY

NUMBER
DPW-01-02

IMSW-HOD-PWE

29 SEP 2005

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Fort Hood's Environmental Policy

1. PURPOSE. To define III Corps and Fort Hood's Environmental Policy concerning Environmental Management System (EMS) implementation requirements.

2. APPLICABILITY. This policy applies to Soldiers, civilian employees, and contractor personnel assigned to or employed by any Fort Hood unit, Fort Hood staff office, tenant organization, or activity assigned, attached, or supported by Fort Hood.

3. BACKGROUND.

a. Executive Order 13148 mandates the Army's policy concerning the implementation of an EMS. Department of Defense is using the International Standard for Organization (ISO) 14001 as the guideline. The EMS assigns command responsibilities and establishes standard operating procedures for environmental compliance.

b. An effective EMS applies best management practices (BMPs) to reduce or eliminate the risk to human health from the release of pollutants and the environment and to assist commanders in complying with Federal, State, and local environmental regulations.

c. The EMS is a management system that will prioritize and focus funds to minimize environmental aspects that impact mission. The EMS results are defensible and provide cost analysis and impact for non-action.

4. POLICY.

a. Fort Hood, a power projection platform in support of the full spectrum of operations, provides responsible stewardship of resources; provides services and maintains infrastructure; enables training of joint/combined expeditionary forces; mobilizes/demobilizes RC forces; establishes a safe, secure environment; provides for the well-being of the DA family; fosters relationships with surrounding communities; and sustains/supports Army transformation.

b. Fort Hood is committed to comply with, and where feasible, exceed applicable Federal, State, and local laws and regulations aimed at sustaining the installation and the environment.

c. Fort Hood shall identify, document, and review environmental objectives and targets to continually improve daily mission activities.

d. Guiding Principles:

(1) All personnel are responsible for protecting and preserving the environment.

(2) Minimize or eliminate waste generation from all operations to reduce impact on the air, water, land, and surrounding community.

(3) Sustain effective partnerships with community stakeholders and remain attentive to their concerns.

(4) Prevent pollution.

e. Managing our natural resources increases our ability to train Soldiers; therefore, EMS is part of Fort Hood's mission.

5. EXPIRATION. This Fort Hood Command Policy memorandum will remain in effect until superseded or rescinded.

THOMAS F. METZ
Lieutenant General, USA
Commanding

DISTRIBUTION:
IAW FH Form 1853: A plus
1 Each III Corps MSC

7.2.1 Environmental Policy

Command Policy DPW-01-02 (29 September 2005) defines Headquarters III Corps and Fort Hood's Environmental Policy. The Environmental Management System (EMS) applies to all personnel performing work for or on behalf of the installation including, but not limited to, Soldiers, civilian employees, and contract personnel assigned to or employed by any Fort Hood unit, Fort Hood staff office, tenant organization or activity assigned, attached, or supported by Fort Hood.

All personnel must be familiar with the EMS policy, and are required to take the 12-minute EMS Awareness Training "Maintaining the Balance" prior to performing any work on the installation. To take the course, log-in at https://lmp.hood.army.mil/lmp/login.aspx , or obtain a copy of the course by contacting DPW-Environmental at (254) 287-8755 or (254) 288-5256.

An effective EMS program reduces the risk to human health and the environment and is used to assist commanders in complying with Federal, State, and local environmental regulations. It is essential, therefore, to initiate the EMS process at the beginning of the site selection process.

7.2.2 Environmental Aspect / Impact Analysis

Fort Hood requires an environmental aspect/impact analysis be conducted for each project during the site selection process.

Environmental Aspect: An element of an organization's activities, products, or services that can interact with the environment.

Environmental Impact: Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's environmental aspect.

The identification of significant environmental aspects is a crucial element in implementing Fort Hood's EMS. The activities, products, and services associated with Fort Hood's mission provide the basis for identifying environmental aspects and impacts. New facility construction is one of the

activities undertaken to support Fort Hood's mission. Environmental aspects of construction activities include the following:

- Air emissions;
- Generation of noise, heat, vibration, or light;
- Waste generation;
- Energy consumption;
- Natural resource consumption
- Storm water
- Wastewater
- Post-construction storm water
- Cultural resource degradation or conservation
- Hazardous materials; and
- Discharges, spills, or other releases to the soil, surface water, or groundwater.

If significant environmental impacts from a project are identified early in the process, modifications to facility siting and design features using sustainable design principles

As environmental aspects are identified, the environmental impacts associated with each aspect are evaluated. The EMS process and the National Environmental Policy Act (NEPA; see Section 7.2.3) are complimentary processes that rely into each other. The Aspects and associated impacts are then examined and prioritized based on environmental, regulatory, mission, and community concerns to determine which are significant. An environmental management program is then developed to address aspects with significant environmental impacts.

In general, the implementation of the sustainable design and development practices and strategies outlined in this IDG is aimed at reducing the overall environmental impacts of facility construction and operations on Fort Hood.

7.2.3 National Environmental Policy Act

The purpose of the National Environmental Policy Act (NEPA) is to incorporate environmental considerations into federal agency planning and action. This is accomplished by providing decision-makers and other stakeholders with information necessary to understand any potentially significant environmental impacts associated with agency proposals. Title 32, CFR Part 651 is the Army's NEPA regulation. Under NEPA, federal agencies must prepare an environmental impact statement (EIS) or an environmental assessment (EA), for any federal action, except those actions that are determined to be "categorically excluded." An EIS is prepared for those federal actions that may significantly affect the quality of the human environment. An EA is a concise public document that provides sufficient evidence and analysis for determining whether or not to prepare an EIS. The EA results in either a "Finding of No Significant Impact" or a decision to prepare an EIS.

An EIS must be submitted to the U. S. Environmental Protection Agency (EPA; an EA is not submitted to the EPA). The EPA reviews and responds to filed impact statements. Information pertaining to environmental impact statements and their submission can be found at the following EPA websites:

- **Environmental Impact Statement (EIS):**
  http://www.epa.gov/ebtpages/envienvironmentalimpactstatement.html
- **Submitting Environmental Impact Statements (EISs):**
  http://www.epa.gov/compliance/nepa/submiteis/index.html

Fort Hood Sustainable Building Site Selection Principles:

1. Plan for compact forms of land development within Force Protection guidelines.
2. Preserve native vegetation, land vital to the mission – rangelands, and land vital to the natural environment.
3. Understand and consider all short-term and long-term consequences of changing the landscape.
4. Reuse of existing facilities and sites before disturbing undeveloped locations.

7.2.4 Water Resource Related Permits

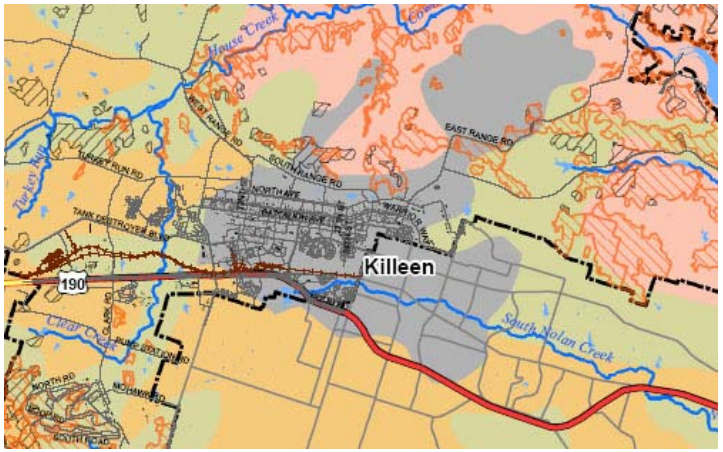
Federal law requires that prior to the undertaking of activities that affect the nation's waterways, described as "navigable waters of the United States" and "waters of the United States" to include wetlands, a permit must be acquired. Information regarding statutory, administrative, and judicial matters, including general regulatory policy, definitions of "waters of the United States" and "navigable waters," and processing of permits can be obtained at the following Corps of Engineers website: http://www.usace.army.mil/inet/functions/cw/cecwo/reg/sadmin3.htm

In Texas, under Construction General Permit TXR150000, construction activities from which runoff goes into surface water or stormwater conveyances that lead to surface water in the state are regulated according to the area of land disturbed.

- Large construction activities that disturb 5 or more acres, or are part of a larger common plan of development that will disturb 5 or more acres, are regulated under this general permit.
- Small construction activities that disturb at least 1 but less than 5 acres, or are part of a larger common plan of development that will disturb at least 1 but less than 5 acres, are also regulated under this general permit.
- Construction activities that disturb less than 1 acre, and are not part of a larger common plan of development that would disturb 1 or more acres, are not required to obtain coverage under this general permit.

7.3 SITE ANALYSIS AND PLANNING

In general, site planning refers to the overall layout of all components of a proposed project within the boundaries of the selected site and addresses the relationship of the site design to the surrounding context. The choice of a site for a project is referred to as site selection. To understand the positive and negative attributes of a particular site during the site selection process, a site analysis or inventory must be performed. To understand what the site planner is looking for in a site, site selection criteria must be developed based on the mission and user need. Therefore, in the end, the optimal "fit" of a project to a site or area can be determined by the site analysis process and subsequent site planning process.



Effective site planning must take into account environmentally sensitive areas such as animal species habitat and vegetation.

7.3.1 Site Analysis Process

The site analysis process helps ensure the proposed site, along with its existing attributes (e.g., infrastructure; drainage, soils) and its potential for improvements meets the mission and user need. The process also examines the adjacent and greater land development land development form to provide understanding about how the form affects the site and, in turn, how the proposed site development might affect the existing land development form. The site selected and how it will be used are two fundamental and interrelated components of site planning. The appropriateness for use of a site for a particular type of action (e.g., building, training) depends largely on site's positive and negative attributes and the surrounding land development form.

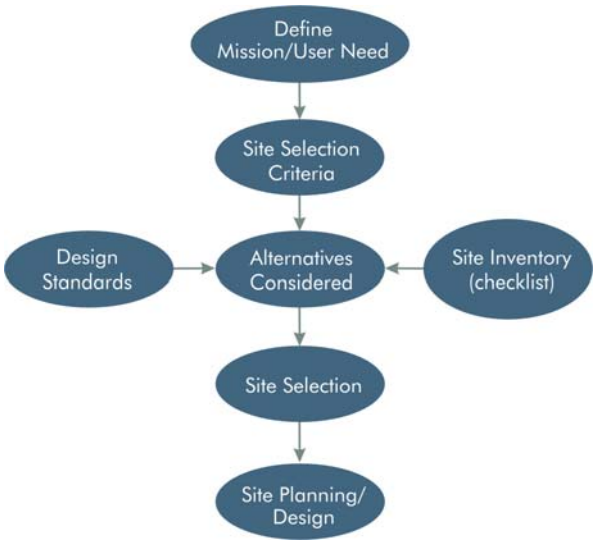


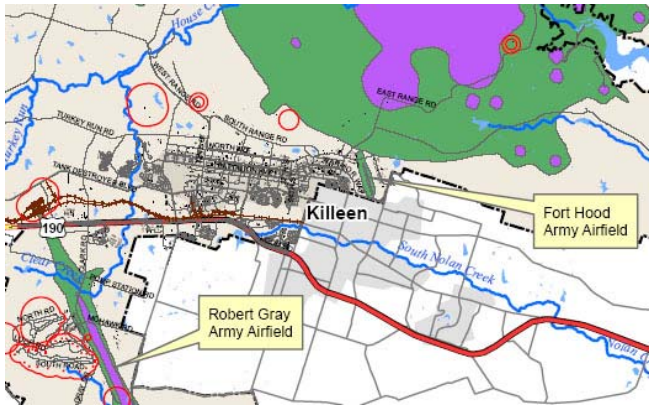
Figure 7-1 Site Analysis Process

The users of a site may include those who live in it, work in it, pass through it, repair it, and even control it. Some user groups at Fort Hood include civilian workers, troops, maintenance, families, etc. Understanding the users and their behaviors and needs is a crucial component to sustainable site planning and the development of site analysis criteria – that is, the attributes a site must have to meet the mission and user need. It is crucial for the site planner to clearly understand the mission and user need at the beginning of the site selection process and to consider these needs in the development of site analysis (selection) criteria.

A key component of the site analysis process at Fort Hood should include a look at past site development choices, and what has been learned and what should be

During the site planning process, the interaction and potential conflict between site attributes and building design elements is better defined. Attributes and elements are considered as a group, and design solution concepts are introduced to reduce conflicts and encourage synergies to minimize resource and project costs while meeting the mission and user need for the site.

The attributes of *alternative site* locations must be inventoried for comparison to the site analysis criteria. The site inventory is a process of identifying the site's existing features and constraints, such as site size, topography, soils, drainage, security, safety, contamination, microclimate (e.g., site's prevailing breezes), views, vegetation, and existing (and abandoned) infrastructure systems and land uses, both on, adjacent to, or in proximity to the proposed site. Table 7-1 provides a *site inventory checklist* for the site planner to use during the alternatives analysis portion of the site selection process and during the facility layout on the selected site. The checklist is designed to remind the site planner to consider the site's attributes (or elements), as well as how those attributes may affect building design elements. For example, although the land area of the site may be large enough to accommodate the proposed building footprint, the site must also allow for correct building orientation (elongated east-west axis) to achieve the building's desired passive solar design features. A preliminary evaluation of the interaction and potential trade offs of site attributes and building design elements is important in the site selection process because it provides a context in which the appropriateness of the site can be evaluated. A preliminary evaluation of the interaction, and potential trade offs, of site attributes and building design elements is important in the site selection process because it provides a context in which the appropriateness of the site can be evaluated.



The understanding of other land use activities that may result in negative externalities (such as noise and safety concerns) is an important part of the site selection and planning process.

It is the point at which the site planner has mission/user criteria, sufficient information to compare alternative site locations, and an understanding of specific *Fort Hood design standards* so that a determination of a suitable *site selection* can be made. Once a site is selected, the site planning process can be initiated. Because mission and user needs for a proposed action sometime change, it is at the completion of the site selection process (if not sooner) that the site planner must validate the originally defined mission and user needs for the site. If there are significant changes in the need, the site selection process may have to be re-initiated.

Section 4, *Installation Profile*, supports this effort by providing general baseline information required to determine whether a site is potentially suitable for its proposed use.

Section 10.3 within Landscape Design Standards provides additional site analytical criteria to use when formulating strategies to enhance exterior spaces and places for public use and habitation

Table 7-1 Site Inventory Checklist	
Site Inventory Characteristics	**Site Selection Consideration**
Site Size	▪ Capacity to accommodate main facility and ancillary structures within design requirements of the Installation Design Guide ▪ Future expansion possible
Topography, Slope	▪ Drainage, flood potential or floodplain location ▪ User views, impact to others' views ▪ Adaptability of facility and ancillary structures to minimize cut or fill ▪ Erosion potential
Soils, Geological, and Hydrological Conditions	▪ Soil suitability for construction/erosion ▪ Groundwater recharge areas ▪ Proximity of karst or other sensitive features, potential contamination pathways
Land Use	▪ Proximity of supporting land use activities ▪ Consistency with Real Property Master Plan ▪ Expected negative effects of the proposed land use on adjacent land uses or the cultural landscape ▪ Expected negative effects of adjacent land uses on the proposed land use
Utility Infrastructure	▪ Size/capacity requirements ▪ Tie-in locations ▪ Impacts of construction on existing utilities, especially drinking water
Abandoned Infrastructure	▪ Proposed facility footprint location ▪ Future removal of infrastructure ▪ Any associated risk
Transportation Access and Capacity	▪ Pedestrian corridors and proximity to the proposed site ▪ Roadway access point locations ▪ Traffic generation from site ▪ Adjacent roadway/signal capacity
Microclimate	▪ Climatic assessment of site, e.g., for (1) building orientation for solar, (2) prevailing breezes (windbreaks, or wind channels), and (3) vegetation for shade
Contamination	▪ Proposed facility footprint location ▪ Future remediation/monitoring work ▪ External sources of contamination to the site
Vegetation	▪ Proposed facility footprint location to minimize disturbance ▪ Construction staging areas ▪ Existing vegetation for shade-solar load benefits and negatives ▪ Value of vegetation for wildlife ▪ Vegetation replacement and maintenance cost ▪ Vegetation removal for security
Waterways and Water Bodies	▪ Parcel size sufficient for buffer ▪ Potential pathways for contamination ▪ Any permits required ▪ Potential for sedimentation
Force Protection/Security Health and Safety	▪ Proximity of facility to fence line ▪ Landforms and land uses adjacent to site (e.g., proximity of plateaus) ▪ Building access points ▪ Proximity of adjacent roads or existing vegetation ▪ Noise contours and accident potential zones ▪ Federal Aviation Administration concerns ▪ Explosive arcs ▪ Weapons safety zones

7.3.2 Site Planning - Design Standards

After completion of the site analysis process, alternative design concepts for the project footprint and other site amenities can be completed based on the information gathered during the site analysis. The information from the site analysis process will make it easier for the site planner to coordinate the site layout with the positive and negative site attributes and building design elements. The focus of the alternative design concepts should be to minimize resource and project costs while meeting the mission and user need for the site.

"Site design deals with three elements: the pattern of activity, the pattern of circulation, and the pattern of sensible form that supports them."

Kevin Lynch

Sustainable design elements must be brought into the site planning process at the earliest stage possible. For example, building orientation and shape are crucial elements to passive solar design and the harvesting of site energy and the eventual energy consumption of the finished building (see Section 8). Opportunities for the integration of low-impact development practices (see Section 10.4.2) for stormwater management must be planned in concert with all other components planned for the site. The same goes for maximizing the use of existing trees and other vegetation, or the planting of new to shade walkways, windows, parking lots, and employee outdoor areas. Vegetation will reduce the "heat island effect" and, for buildings, will reduce cooling energy demand.

The following site planning design standards are actions to meet the site planning objectives and desired end state of site planning for the installation; that is, to produce an attractive, sustainable development that enhances mission readiness.

Fort Hood is committed to maintaining natural ground slopes and elevations by:

- Aligning roadways and buildings along topographic lines;
- Locating facilities that have expansive ground coverage on relatively flat terrain;
- Using moderately sloping areas for buildings with less ground coverage area; avoiding development on steep slopes; and
- Adapting the building to the contour of the land to minimize cut.

New construction, when necessary, should be seen as an extension of the present built fabric, not as independent, self-contained development.

Hannover Principles

Fort Hood is committed to minimizing disturbance to natural drainage corridors, floodplains, waterways, geological, and hydrological systems by:

- Protecting and maintaining natural drainage, wetland, and waterways and bodies by avoiding development within, considering them a positive attribute in the design layout for the site, and providing vegetative buffers with a minimum setback of 50 to 100 feet;
- Limiting development in floodplains to open spaces and passive recreational uses;
- Protecting significant karst features;
- Protecting hydrological systems (and the pathways) from contamination during and after construction;
- Controlling erosion during and after construction through the use of vegetation, grading, soil stabilization, and capturing stormwater runoff (e.g., Low Impact Development [LID]; see Section 10).

Fort Hood is committed to site planning for sustainable practices by:

- Understanding Fort Hood climate conditions (see Section 4.3.4 and Appendix Q) and the effect the climate has on “whole” or “green” building design (see Sections 8.13 and 8.14);
- Considering the shape and orientation of buildings on the site;
- Incorporating LID practices for stormwater management;
- Reducing heat islands by using landscaping and building design methods (e.g., reflection roofs, tree shading);
- Using landscape for the restoration of degraded areas and to buffer harsh natural conditions (e.g., wind);
- Using porous alternatives (see Section 9) to traditional paving for parking lots, roads, and walkways;
- Clustering buildings to reduce impact on the natural environment, and reducing roadways and utility corridors needed to serve the development; and

“Heat islands" are created principally by manmade surfaces, including dark roofs, asphalt lots and roads, which absorb most of the sunlight falling on them and reradiate that energy as heat. Areas with fewer trees and other natural vegetation to shade buildings, block solar radiation and temperatures caused by the urban heat island have increased cooling energy demand for buildings.

- Providing for functional outdoor space with comfortable climatic exposures (e.g., shaded areas) for the user of Fort Hood, to include stationary and pedestrian way facilities.

Fort Hood is committed to protecting and enhancing the cultural landscape and natural views by:

- Locating building fronts close to the roadway (this action must be reviewed for force protection concerns and site layout consistency with adjacent land uses);
- Locating parking lots and access points at the rear of buildings to minimize the visual impact of broad expanses of pavement and vehicles (this action must be reviewed for force protection concerns and site layout consistency with adjacent land uses);
- Using multiple small parking lots is preferable to single large lots because they enhance the visual environment by increasing the percent of landscaped area to paved area and allow more conformance to natural topography;
- Locating buildings and other site amenities (e.g., communication towers) to minimize the visual impact to natural views (e.g., avoid building facilities within plateaus/hill areas or other prominent locations that are considered scenic);
- Evaluating the impact of the proposed action on the adjacent and greater land development form and cultural landscape;
- Reinforcing and protecting the original circulation grid system;
- Locating utility lines below ground;
- Using site furnishing materials (e.g., fences) and plant material to screen unattractive views; and
- Locating roads to blend with topography and vegetation.

Aboveground utilities have a negative effect on views. Fort Hood is committed to the installation of underground utilities for new construction. For existing aboveground utilities, carefully selected trees can help screen the visual liability.

Inadequate protection of the root system during construction can compromise vegetation survival. Appropriate distances need to be maintained.

Fort Hood is committed to minimizing habitat disturbance and to the protection and enhancement of native vegetation by:

- Orienting buildings on site to minimize land disturbance and to retain native vegetation features to the extent possible (this must be balanced with the preferred building orientation, adjacent land uses, and force protection);
- Reducing building and paving footprints;
- Avoiding soil compression during construction near protected vegetation or where future landscaping is expected to occur; and
- Limiting site disturbance to a minimal area around the building perimeter.

Other Site Design Standards/Conditions

- **Preservation of Native Trees.** In the cantonment area, native hardwood trees that are greater than 3 inched in diameter measured at 4 feet from the ground must be preserved. If removal is absolutely necessary, ten native trees must be planted for each tree removed (10:1 ratio). Each replacement tree shall be a minimum of 2 inches in caliper and must be selected from the Plant Pallette shown in Appendix I. Fort Hood prefers protection of native trees over replacement.
- **Protection of Trees During Construction.** Trees that are to be preserved will be protected during construction by placement of fencing at the tree dripline. Trees will be protected from unnecessary cutting or breaking of roots, skinning or bruising of bark, stockpiling construction materials within the dripline, excess foot or vehicular traffic, and parking of vehicles within the dripline. During the installation or removal of fill materials, the grade is not to be altered by more than 2 inches within the dripline of any of the preserved trees.
- **Site Analysis for Landscaping.** Site analysis procedures for landscaping are an important aspect of the site planning effort. Whether the designer is using landscaping features to modify a building's interior or exterior climatic environmental conditions, improve security and defensible space around the perimeter of a building, or visually enhance an area through the use of vegetation and other landscape enhancements, site-specific landscape plans that acknowledge existing site conditions (drainage patterns, solar orientation, circulation and use)

as well as appropriate plant materials for the geographic location are required. See Section 10.3 for detailed procedures and Appendix I for plant material.

- **Security/Force Protection.** Security measures built into a project, such as setbacks, bollards, and structural hardening, must be considered in the overall site planning process because they affect the spatial relationship between elements (e.g., parking, building orientation, etc.) of a project. In addition, opportunities for attack/threats must be considered when locating building types with different acceptable levels of risk. Potential attacks/threats may include, but are not limited to:

  - Unauthorized entry,
  - Explosive threats: Stationary and moving vehicle-delivered, mail bombs, package bombs, and
  - Ballistic threats: Small arms, high-powered rifles, drive-by shootings, etc.

  As such, security issues must be addressed in concert with other site planning objectives and integrated into the overall site analysis and site planning design early in the process to ensure a building with effective security. Security/force protection requirements should be designed and located to blend with the physical environment. As discussed in Section 12, the primary DoD document for security requirements is found in UFC 4-010-01, *DoD Minimum Anti-Terrorism Standards for Buildings.*

- **Accessibility.**

  - Any building or facility used only by able-bodied personnel need not be accessible to the disabled. Nevertheless, when feasible and appropriate, seek to incorporate accessibility measures into the design since the facility use may change over time (military exclusion is provided by UFAS 4.1.4 (2)).
  - All other structures or facilities must meet the standards of the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and the Uniform Federal Accessibility Standards (UFAS), with the most stringent standards applied in the event of conflicting guidelines. (See AR 420-70, Chapter 2, Paragraph 2.8). This includes the avoidance of site barriers through the use of curb cuts, ramps, handrails, and grade-level entrances to avoid site barriers.

- Provide designated handicapped parking spaces in all major parking lots and drop-off zones for persons with mobility impairments.
- Modify existing structures for handicapped accessibility whenever possible, especially community facilities that are most likely to be used by families, veterans, or visitors.

7.4 ARMY STANDARDS

The cited Army Standards shall be met.

- **UFC 3-210-06FA, *Design: Site Planning and Design*** (http://www.hnd.usace.army.mil/techinfo/UFC/UFC3-210-06A/UFC3-210-06A.pdf).
- **Americans with Disabilities Act Accessibility Guidelines (ADAAG)** (http://www.access-board.gov/adaag/html/adaag.htm).
- **Uniform Federal Accessibility Standards (UFAS)** (http://www.access-board.gov/ufas/ufas-html/ufas.htm).
- **AR 200-2, *Environmental Effects of Army Actions*** (http://www.usapa.army.mil/pdffiles/r200_2.pdf).

7.5 REFERENCES

The following references are provided for guidance.

- AR 210-20, *Master Planning for Army Installations*, http://www.usapa.army.mil/pdffiles/r210_20.pdf
- AR 420-70, *Facilities Engineering, Building and Structures,* http://www.hqda.army.mil/acsimweb/fd/policy/ar420-70/index.htm
- Army NEPA Regulations, Title 32, CFR Part 641, http://www.access.gpo.gov/nara/cfr/waisidx_01/32cfr651_01.html
- Army Command Policy DPW-01,

- Technical Instructions (TI) 800-01, *Design Criteria*, http://www.hnd.usace.army.mil/techinfo/ti/800-01/ti80001a.htm
- Technical Instructions (TI) 801-02, *Family Housing*, http://www.hnd.usace.army.mil/techinfo/ti/801-02/famhouse.htm
- Texas Commission on Environmental Quality, TPDES Construction General Permit, Permit No. TXR150000, issued by the Environmental Protection Agency Region 6, Dallas, Texas, http://www.tceq.state.tx.us/assets/public/permitting/waterquality/attachments/stormwater/txr150000.pdf and Storm Water Permits for Construction, http://www.tceq.state.tx.us/nav/permits/wq_construction.html.
- UFC *2*-600-01*, Installation Design,* Chapter 7*,* http://knxas1.hsdl.nps.navy.mil/homesec/docs/dod/nps03-080504-01.pdf
- UFC 3-210-01A, *Design: Area Planning, Site Planning, and Design,* http://www.hnd.usace.army.mil/techinfo/UFC/UFC3-210-01A/UFC3-210-01A.pdf
- UFC 3-210-06FA, *Design: Site Planning and Design*, http://www.hnd.usace.army.mil/techinfo/UFC/UFC3-210-06A/UFC3-210-06A.pdf
- UFC 3-230-15FA, *Design: Subsurface Drainage Facilities for Airfields and Heliports*, http://www.hnd.usace.army.mil/techinfo/UFC/UFC3-230-15FA/UFC3-230-15FA.pdf
- UFC 3-230-16FA, *Design: Drainage and Erosion Control Structures for Airfields and Heliports*, http://www.hnd.usace.army.mil/techinfo/UFC/UFC3-230-16FA/UFC3-230-16FA.pdf
- UFC 3-230-17FA, *Design: Drainage for Areas Other than Airfields*, http://www.hnd.usace.army.mil/techinfo/UFC/UFC3-230-17FA/UFC3-230-17FA.pdf
- UFC 3-230-18FA, *Design: General Provisions and Geometric Design for Roads, Streets, Walks, and Open Storage Areas*, http://www.hnd.usace.army.mil/techinfo/UFC/UFC3-230-18FA/UFC3-230-18FA.pdf
- UFC 3-250-01FA, *Design: Pavement Design for Roads, Streets, Walks and Open Storage Areas*, http://www.hnd.usace.army.mil/techinfo/UFC/UFC3-250-01FA/UFC3-250-01FA.pdf

- UFC 3-260-02, *Design: Pavement Design for Airfields*, http://www.hnd.usace.army.mil/techinfo/UFC/ufc326002H/ufc3-260-2.pdf
- UFC 3-400-01, *Design: Energy Conservation*, http://www.hnd.usace.army.mil/techinfo/ufc/081602_UFC3-400-01.pdf
- UFC 4-010-01, *DoD Minimum Anti-Terrorism Standards for Buildings,* http://www.wbdg.org/references/ccbdoc.php?i=106&r=1
- Reducing Heat Islands, http://eetd.lbl.gov/HeatIsland/
- Whole Building Design, http://www.wbdg.org/

The design character of an installation's buildings affects the installation's overall image. The visual analysis of buildings and related structures helps define visual zones and themes and is an important part of an installation's assets and liabilities assessment.

The building design component encompasses the character of the buildings as well as the arrangement of buildings in relation to one another and to their environment. In general, use architectural style, materials, and colors indigenous to the region. The preservation of historically and culturally significant structures adds to an installation's character and provides a sense of heritage.

The visual analysis of structure also includes concern for accessibility, use of materials, placement of entrances, incorporation of additions and renovations, the incorporation of plazas and courtyards, interior design, and the appropriateness and quality of building maintenance. This section provides the objectives and visual determinants that should be used to identify and assess the installation's building design quality. The section also provides standards and guidance pertaining to the development and maintenance of the various interiors and exteriors of buildings on the installation.

8.1 BUILDING OBJECTIVES

8.1.1 Sustainability

The architectural style of existing and future buildings should reflect and reinforce the consistency and sustainability of the installation. Sustainable design reduces construction and maintenance costs and conserves energy through responsive construction and materials selection. See Section 1 and Appendix D: LEED Checklist for a more complete discussion on sustainable design.

8.1.2 Building Design Objectives

1. Adapt building designs to natural site conditions and capitalize on the existing site topography and its relationship to adjacent sites.
2. Design buildings in clusters to preserve land as determined important, reduce construction and maintenance costs.
3. Design buildings to preclude future pest (wildlife, insect) problems (see Sections 8.16 and 10.9.6).
4. Design buildings for the sustainable use of materials, energy efficiency, and safety.
5. Develop a coherent architectural style in each of the zones that results in the blending of new and existing structures.
6. To make efficient use of limited installation land areas, minimize the building's footprint by adding additional floors in a vertical structure to economize on land consumption.
7. Combine multiple activities in one building to reduce the number of buildings required, making more efficient use of limited installation land areas.
8. To accommodate changing needs, design multiple-use facilities with capability to quickly change interior configurations.
9. Use indigenous construction materials and practices that require less energy and transport.
10. Select materials that can be recycled at the end of their usefulness.
11. Design buildings to protect the cultural landscape and outward views.

12. Consider adaptive reuse rather than demolition of buildings once their initial use is no longer required.

8.2 STRUCTURAL CHARACTER

The character of installation architecture varies according to the use of the structure and when it was built. This use and age variation can also result in character incompatibilities. Difference in character may result when the designer ignores the character and scale of adjacent buildings or uses an imitative technique unsuccessfully. These incompatibilities can add confusion to the user and be disruptive to usage and base understanding.

The coordination of structural character on an installation provides a consistent and coherent "sense of order" and "sense of place." This relationship of design comes from using compatible scale, massing, form, color, texture, materials, and fenestration. These design techniques can be used in the visual review and analysis of the installation and are explained in more detail in the following subsections.

8.2.1 Scale

Scale refers to the size of a building in relation to humans and adjacent structures. Buildings that include predominant vertical facades are defined as monumental in scale. Monumental architectural design is typically used for ceremonial buildings, such as worship centers, and headquarters complexes. These buildings make use of large, glazed areas at entrances and oversized fenestration elements to create a scale appropriate to the building's presence and architectural statement.

Buildings with more horizontal facades designed to more closely relate to the size of the human figure are defined as human scale. The scale of most installation buildings should be more human than monumental. All new construction at Fort Hood should be compatible in scale with adjacent buildings. Scale and human detail should be provided through roof form, fenestration, building articulation, and landscape plantings.

8.2.2 Massing

Massing refers to the overall bulk or volume of a building or buildings. The size and proportion of the individual buildings within a group should be designed to be proportionally compatible with the adjacent structures and compatible with its function.

8.2.3 Form

The form of a building is determined by its size, mass, shape, and proportions. The use of similar building forms provides continuity to the installation's architectural impact. The result is a more aesthetically pleasing environment and clarity to the user.

8.2.4 Color

The use of a consistent color scheme throughout the installation, where possible, results in a continuity of buildings and contributes to an overall sense of place. Although, color schemes throughout Fort Hood often vary according to the visual zone and visual theme in which the structure is located.

8.2.5 Texture

The use of materials similar in texture helps provide visual continuity for the buildings on the installation. The utilization of indigenous and local vernacular will aid to sustain design practices.

8.2.6 Materials

The use of the same materials in a building's exterior finish and trim helps provide visual continuity. Materials will address the local vernacular and should be obtained locally in order to minimize transportation costs.

8.2.7 Fenestration

Building fenestration includes features such as doors, windows, and building exterior details. These features will be similar in arrangement, design, size, and proportion for architectural compatibility and visual consistency.

8.3 BUILDING ENTRANCES

A building entrance is a primary feature of any building design. Within security limitations, all building entrances will be defined and recognizable as the point of entry regardless of the building's size or importance.

The entrance to a building will be in a prominent location and will be oriented toward the primary adjacent public spaces, such as any courtyard, lawn, parking lot, or street. The details of an entrance will be designed to provide continuity with other entrances to adjacent buildings.

8.4 SERVICE AREAS

Service areas, such as loading docks and trash dumpsters, will be screened from the views of primary use areas such as entrances, courtyards, gathering areas, streets, and parking lots. Service areas will be screened by walls and landscaping. Screen walls will be between 6 and 8 feet high and will be in harmony with the adjacent building.

Trash and garbage collection areas must be located a minimum of 25 meters (82 feet) from troop billeting, family housing areas (containing more than 12 units), and stand-alone retail facilities. They will be placed a minimum of 10 meters (33 feet) from all other inhabited structures (Unified Facilities Criteria (UFC) 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*, Table B-1).

8.5 BUILDING ACCESSIBILITY

All structures or facilities, other than the exceptions mentioned below, must meet the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and the Uniform Federal Accessibility Standards (UFAS) accessibility standards. The more stringent standards apply in the event of conflicting guidelines.

Any building or facility that is specifically restricted by occupancy classification for use only by able-bodied personnel during the expected useful life of the building or facility need not be accessible (military exclusion is provided by UFAS 4.1.4 [2]), but accessibility is recommended since the intended use of the facility may change with time. In particular, the following facilities need not be designed to be accessible: unaccompanied personnel housing, closed messes, vehicle, and aircraft maintenance facilities.

8.6 SEISMIC POLICY

8.6.1 Substantial Life-Safety

The minimum performance objective for Army facilities is substantial life-safety. To ensure compliance, seismic evaluations and mitigation of unacceptable seismic risks will be performed. Higher levels of seismic protection for mission-essential facilities will be considered in the evaluation.

8.6.2 Seismic Design Requirements

All permanent and semi-permanent structures on Fort Hood will meet structural design requirements for seismic loads as follows:

- Short-Period Response Accelerations (SS) = 0.090g,
- 1-second Period Response Acceleration (S1) = 0.050g,
- Seismic Use Group and Seismic Design Categories shall be determined for individual buildings.

Seismic Design and construction shall conform to the following:

- UFC 3-300-10, Design: General Structural Requirements,
- UFC 3-310-03A, Design: Seismic Design for Buildings, and
- 2003 International Building Code.

Seismic Evaluation

Guidance for the seismic evaluation of existing facilities is given in UFC 3-301-05A, Seismic Evaluation and Rehabilitation for Buildings.. Buildings will have a seismic evaluation performed when:

- A change in the building's use causes a change in the occupancy category, as defined in UFC 3-310-03A, Design: Seismic Design for Buildings, to a category of greater importance (lower category number);
- A project is planned which causes the capacity of the structural system or components to be reduced to 90% or less of original stability and strength;
- A project will significantly extend the facility's useful life or will significantly increase the facility's value and the cost exceeds 50% of the current replacement value; or
- A facility is damaged or is deemed to be an exceptionally high risk to occupants or to the public.

8.6.3 Exceptions to Seismic Evaluations

Existing facilities are generally exempt from seismic evaluation if:

- The original design was done according to the provisions of the 1982 or later edition of TM 5-809-10, *Seismic Design for Buildings*, or the 1988 or later edition of TM 5-809-1;
- Replacement is scheduled within five years;
- The facility is intended only for minimal human occupancy and is occupied by persons for a total of less than 2 hours a day;
- The facility is a one- or two-family dwelling, two stories or less, located in zones 1 or 2, as shown in TM 5-809-10, Seismic Design Guidelines for Upgrading Existing Buildings; or
- The gross area is less than 3,000 square feet (275 square meters).

8.6.4 Mitigation of Unacceptable Seismic Risks

If the seismic evaluation determines that the facility does not meet substantial life-safety or higher performance standards, as appropriate, unacceptable seismic risks will be mitigated. Rehabilitation will be performed in accordance with UFC 3-301-05A, Seismic Evaluation and Rehabilitation for Buildings.

8.6.5 New Facilities or Additions or Extension of Existing Facilities

New facilities and additions or extension of existing facilities will be designed to provide the level of seismic protection required by UFC 3-310-03A, Seismic Design for Buildings.

8.6.6 References and Resources Related to Seismic Policy

- UFC 3-301-05A, Seismic Evaluation and Rehabilitation for Buildings, http://www.wbdg.org/ccb/DOD/UFC/ufc_3_301_05a.pdf.
- UFC 3-300-10, Structural Engineering, http://www.wbdg.org/ccb/DOD/UFC/ufc_3_300_10n.pdf.
- UFC 3-310-03A, Seismic Design for Buildings, http://www.wbdg.org/ccb/DOD/UFC/ufc_3_310_03a.pdf.

- TM 5-809-10, *Seismic Design for Buildings*, http://www.usace.army.mil/inet/usace-docs/armytm/tm5-809-10/

- TM 5-809-10-2/NAVFAC P-355.2/AFM 88-3, Chapter 13, Section B, *Seismic Design Guidelines for Upgrading Existing Buildings*, http://www.usace.army.mil/inet/usace-docs/armytm/tm5-809-10-2/

8.7 INDIGENOUS STRUCTURES

Sustainability in building design and construction includes incorporating time-proven building designs that are indigenous to the region. Indigenous design elements, which can include overhangs, operable windows, shading devices, site-responsive placement of structures, drainage considerations, material usage, and energy-conscious designs, will be incorporated in the design of new buildings.

8.8 HISTORIC ARCHITECTURE

The visual integrity of historic buildings or districts on the installation will be preserved and protected. The Army's management of historic properties is pursuant to the duties and responsibilities established by Congress under the National Historic Preservation Act (NHPA). The NHPA also created the National Register of Historic Places (NRHP) as the official listing of the nation's historic properties considered worthy of preservation. When working with historic properties, the Army uses the following three categories:

- **Historic Buildings or Structures.** These are significant buildings or structures that are listed in or eligible for listing in the NRHP.

- **Historic District.** A distinct group of buildings, structures, or landscapes that possesses significance and is listed in or eligible for listing in the NRHP.

- **National Historic Landmarks.** Buildings, structures, or landscapes listed in the NRHP, but also recognized as nationally significant. National Historic Landmarks can either be listed individually or as a district.

Specific to Fort Hood, consideration must be given to buildings, structures, and landscapes when proposing rehabilitation, demolition, new construction, etc. Several buildings and locations are designated with historical significance:

- Building 4166, Black (Burba) House in the Natural and Cultural Area, West Main Cantonment;
- Building 8640, Reynolds House, currently Red Cross facility, East Main Cantonment;
- Buildings 44, 53, and 1871, comprise the Camp Hood Historic District, Central Main Cantonment;
- Capehart-Wherry Era Housing includes all original housing within McNair Village, Chaffee Village, Montague Village, Patton Park, Walker Village, Wainwright Heights, and Pershing Park. The Capehart-Wherry Era National Agreement negates the need for further consultation with the State Historic Preservation Officer when a project regarding these facilities is in the planning stages. However, since the agreement states the Army considers these facilities as eligible for listing on the National Register of Historic Places, there is still the requirement to consult with the installation Cultural Resource Program Manager: 254-287-1092.
- Fort Hood Historic Landscape: This applies primarily to the Main Cantonment; however, there are aspects that may apply to West Fort Hood when the on-going Inventory and Assessment is completed. This landscape encompasses key use areas that were established during the creation of Camp Hood and persist to today. The Cultural Resource Program Manager (254-287-1092) can provide simplified maps during planning consultation to assess the impact of proposed projects on this historic landscape. For further guidance use Army Regulation (AR) 200-4 and Department of the Army Pamphlet 200-4 (*Cultural Resources Management*). Specific requirements and recommendations for the treatment of historic properties are available in the National Park Service's Secretary of the Interior's Standards for the Treatment of Historic Properties. A working awareness of historic preservation policies and procedures followed by the Army Corps of Engineers can be found in the Technical Instruction (TI) 800-01, *Design Criteria*, Chapter 16, "Preservation of Historic Structures."

8.9 RENOVATIONS AND ADDITIONS

When existing buildings are renovated or additions are constructed, the architectural character of the renovation or addition will be compatible with the architectural character of the existing building and the adjacent buildings. This compatibility includes the use of materials, color, shape, size, scale, and massing in the addition or renovation that blends with the architectural character of the existing structure. Although existing historical buildings are not numerous on the installation, when such a building is renovated or added on to, differentiation should be made between the historic fabric and the new material.

8.10 PLAZAS AND COURTYARDS

Plazas and courtyards can be designed as part of the primary entrance to a building or as an extension of non-primary entrance areas to the outside. These areas soften the abruptness of building facades and provide welcoming arrival elements, as well as shelter from the Texas summers. Wide, paved entrance plazas need vehicular barriers that follow antiterrorism/force protection standards, as well as aesthetics.

8.11 BUILDING MAINTENANCE

Buildings designed and constructed to incorporate sustainable design criteria should minimize life cycle, energy, and maintenance costs through proper selection of forms, materials, and construction details. The appropriate selection of long-lasting materials extends building life and creates desirable structures that withstand the damages of time and use.

8.12 BUILDING INTERIOR COMPONENTS

Inhabited spaces that require the selection of furnishings or equipment should be designed by professional architects and interior designers. Interior design impacts people's functioning and productivity. People spend the majority of their time inside, working, eating, sleeping, and relaxing. The productivity, comfort, and safety of the personnel living, working, or relaxing in the facilities they inhabit is directly related to the quality of interior design provided within the facility.

Interior design is required on building construction and renovation projects regardless of the funding source. General interior design guidance and interior design guidance for medical facilities and family

housing are provided in the following documents. Appendix C of this IDG contains an Interior Design Checklist which may be used during project development.

- **General Guidance**. Unified Facilities Criteria (UFC) 3-120-02AN, Design Guide for Interiors.
- **Medical Facilities**. Interior design guidance for medical facilities is furnished in Unified Facilities Criteria (UFC) 4-510-01, Design: Medical Military Facilities.
- **Family Housing**. Interior design for family housing will be in accordance with TI 801-02, *Family Housing*.

Engineering Regulation (ER) 1110-345-122, *Engineering and Design, Interior Design* defines projects that require interior design, design requirements and responsibilities of participants, and methods and funding for execution of interior design. For cost estimating see Air Force Interior Design Guides, Chapter 3, Cost Estimating Guide.

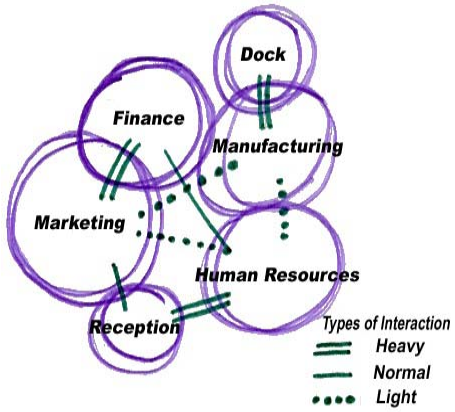
Questions related to interior design work at Fort Hood should be directed to the Chief of Master Planning at Fort Hood: 254-287-7297 or 254-287-3528 or the USACE, Fort Worth, Interior Designer: 817-886-1766.

8.12.1 Space Planning

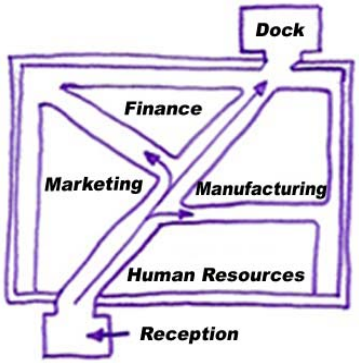
Space planning is the basic building block of the facilities program for administration and operational facilities. Appendix D of the AR 405-70, *Utilization of Real Property*, provides numerical planning allowances and addresses the quantities for programming space for personnel and equipment.

Space planning takes into consideration the following: who will be using a space, how the space will be used, what activities will take place there, and the interaction of other people in the building. Professionally trained interior designers and architects are best at gathering the required information to formulate a space utilization plan.

Bubble Diagrams. Bubble diagrams show the working relationship of one group to another. The adjacency requirements for individuals, user groups, and support functions to accomplish the product or service provided are analyzed and illustrated graphically. Bubble diagrams can assist in organizing both existing and new facilities.



A typical bubble diagram indicating group relationships.



A typical blocking diagram demonstrating the fit into the floor plan.

Blocking Diagram. The blocking diagram is a further development of the bubble diagrams. The blocking diagram fits into the proposed floor plan.

The next step in the process is the development of the actual space plan. The layout of the space plan is detailed to the workstation level.

8.12.2 Color

Color plays an important role in the design of interior environments and has a large impact on how occupants feel and behave in a space. Its quality affects emotions directly and immediately. Successful interior designs harmonize form, space, light, and color.

Information on color and light, optical effects, basic color theory, color schemes, and applying color in facilities can be found in UFC 3-120-02AN, Design Guide for Interiors, and in Chapter 9, Color Principles, Part 1 and Part 2 of the Air Force Interior Design Guides.

8.12.3 Acoustics

Acoustics, as an environmental variable, significantly impact the human impression and success of an interior environment. Productivity, speech intelligibility, privacy, safety, positive user attitude and response, and environmental comfort all depend on proper acoustic design. The designer is concerned with reducing unwanted noise and preserving and controlling desirable sound in a space. Sound can be controlled generally in three ways: eliminate the source, isolate the source (i.e., provide a barrier between the user and the source), or mask the offending sound.

A discussion of the dynamics and control of acoustics can be found in UFC 3-120-02AN, Design Guide for Interiors.

8.12.4 Interior Finishing Elements

Interior finishing elements include items such as flooring (carpet, tile, resilient flooring, recessed walk-off mats, concrete), walls (wall base, paint, vinyl wall covering, ceramic tile), counter and surface material (restrooms, cabinetry), doors, ceilings, and lighting. These building materials are used to design the interior space of the building and can affect occupant comfort, productivity, safety, and overall lifecycle maintenance and operational costs.

8.12.4.1 Standards for Fort Hood Interior Finishing Elements

Interior finish standardization is important for administrative and financial reasons. Standardization presents a unifying element throughout all buildings that is more cost effective, efficient, and easy to maintain. Standards for interior finishing for particular areas of Fort Hood are found later in this section. The interior materials preferred for use by Fort Hood are discussed below. These materials have been selected by Fort Hood because they promote occupant comfort, productivity, and safety. The Independent Certification Programs listed on the following page provide preferred guidance in the selection of materials for furnishings.

Green Seal is one of the Independent Certification Programs. It is a non-profit organization that strives to achieve a healthier and cleaner environment by identifying and promoting products and services that cause less toxic pollution and waste, conserve resources and habitats, and minimize global warming and ozone depletion.

Table 8-1
Volatile Organic Compound Limits for Paint, Clear Wood Finishes, Floor Coating, Stains, and Shellacs

Paint Applications		VOC Content Limit[a] (grams of VOC per liter)
Interior Coatings (GS-11)	Flat	50
	Non-Flat	150
Exterior Coatings (GS-11)	Flat	100
	Non-Flat	200
Anti-Corrosive/Rust (GC-03)	Gloss	250
	Semi-Gloss	250
	Flat	250
Clear wood finishes	varnish	350
	lacquer	550
Floor coating		100
Sealers	water proofing sealers	250
	sanding sealers	275
	all other sealers	200
Shellacs	clear	730
	pigmented	550
Stain		250

Note:
[a] Excluding water and tinting added at the point of sale.

Source: Green Seal and South Coast Air Quality Management District Rule 113, Architectural Coating, rule in effect on January 1, 2004.

8.12.4.2 Paints and Coatings

Paint is a potential contributor to poor air quality, both indoor and outdoor, due to volatile organic compound (VOC) emissions. Fort Hood requires that regardless of the paint type chosen, the product must be certified in compliance with Green Seal requirements for VOC limits (Table 8-1) and chemical component restrictions.

In addition to toxicity, recycled content should be considered. Recycled latex paint made primarily with leftover but unused latex paint that has been brought to local household hazardous waste facilities by residents, painting contractors, and other paint users is available. Reprocessed latex paint with recycled content from 20% (white, off-white, and pastels) to 99% (gray, brown, earthtones, and other dark colors) is also available. In addition, consolidated latex (no color designation) with up to 100% recycled content is available. Other paints to consider are bio-based products.

Table 8-2 Reflectance Value of Paints	
Paint Color	**Reflectance**
Semi-Gloss White	70%
Light Green	53%
Kelly Green	49%
Medium Blue	49%
Medium Yellow	47%
Medium Orange	42%
Medium Green	41%
Medium Red	20%
Medium Brown	16%
Dark Blue-Gray	16%
Dark Brown	12%

Note: All values are for flat paint, except semi-gloss white. For gloss paints, add 5% to 10%.

Source: Energy Design Guidelines for High Performance Schools, Temperate and Humid Climate

Designers were careful to use light-colored surfaces to enhance daylighting in this classroom at Oberlin College's Adam Joseph Lewis Center for Environmental Studies.

Interior surfaces such as walls, ceilings and floors are important light reflectors. The color of these surfaces can significantly impact interior lighting demands and visual comfort in interior spaces (Table 8-2). Light-colored walls and ceilings increase light reflectance and reduce lighting and daylighting requirements. The reflectance value of paints must be considered in interior design.

8.12.4.3 Adhesives and Sealants

Adhesives and sealants are similar to paints in regard to indoor air quality concerns. These materials can contain VOCs and other toxic chemicals that can be released during construction and post occupancy. All adhesives and sealants used in onsite construction at Fort Hood are required to comply with air quality standards as shown in Table 8-3. Bio-based products should also be considered.

8.12.4.4 Wallboard and Wallcoverings

Interior walls are generally covered with drywall and finished off with either paint or a wallcovering. Drywall is composed primarily of gypsum and paper and is available with up to 100% recycled content. Fort Hood requires that all new drywall contain at least 20% post-consumer or 40% post-industrial recycled content.

The **GREENGUARD Environmental Institute** (GEI) is an industry-independent, non-profit organization that oversees the GREENGUARD Certification Program for low-emitting products, including the establishment of acceptable standards for interior products and testing protocols. The GEI's mission is to improve public health and quality of life by helping manufacturers build better and safer products and to provide the public with a free indoor air quality resource and guide to readily available low-emitting products.

Many types of wallcoverings are available from manufacturers. Interior designers should consider natural materials, such as sisal, jute, bamboo, plaster, or clay tiles, or manufactured products that pass GreenGuard standards (Figure 8-1) for indoor air quality. A recyclable wallcovering composed of polyester, nylon, and cellulose is also available. Any adhesives used in onsite construction at Fort Hood must meet VOC limits presented in Table 8-3.

Independent Certification Programs

Third-party Certification and Screening Programs Related to Green Buildings

The FloorScore program, developed by the Resilient Floor Covering Institute (RFCI) in conjunction with Scientific Certification Systems (SCS), tests and certifies flooring products for compliance with indoor air quality emission requirements adopted in California. http://www.rfci.com/int_FloorScore.htm

The LEED (Leadership in Energy and Environmental Design) Green Building Rating System® is a voluntary, consensus-based national standard for developing high-performance, sustainable buildings. http://www.usgbc.org/DisplayPage.aspx?CategoryID=19

FSC (Forest Stewardship Council) is an international not-for-profit membership-based organization that brings people together to find solutions to the problems created by bad forestry practices and to reward good forest management. http://www.fsc.org/en/

ENERGY STAR is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy helping us all save money and protect the environment through energy efficient products and practices. http://www.energystar.gov/index.cfm?c=about.ab_index

The CRI (Carpet and Rug) Indoor Air Quality Carpet Testing Program green and white logo displayed on carpet samples in showrooms informs the consumer that the product type has been tested by an independent laboratory and has met the criteria for very low emissions. http://www.carpet-rug.com/drill_down_2.cfm?page=8&sub=6

Green Seal is an independent non-profit organization dedicated to safeguarding the environment and transforming the marketplace by promoting the manufacture, purchase, ad use of environmentally responsible products and services. http://www.greenseal.org/

GEI [Greenguard Environmental Institute] is an industry independent, non-profit organization with mission to improve public health and the quality of life through programs that improve indoor air." http://www.greenguard.org/DesktopDefault.aspx

SCS (Scientific Certified systems) is an internationally recognized independent certifier of environmental and food safety claims. Over two decades, SCS has developed standards and offered certification programs spanning a wide cross-section of the economy including agricultural production, forestry, fisheries, energy, consumer products, manufacturing and retailing, and the home improvement and construction sectors. http://www.scscertified.com/

Figure 8-1 Independent Certification Programs

Table 8-3
Volatile Organic Compound Limits for Adhesives and Sealants

Adhesive Application	VOC Content Limit (grams/liter less water)	Adhesive Applications	VOC Content Limit (grams/liter less water)
Architectural		**Specialty**	
Indoor carpet	50	Polyvinyl chloride (PVC) welding	510
Carpet pad	50	Chlorinated polyvinyl chloride (CPVC) welding	490
Outdoor carpet	150	Acrylonitrile-butadiene-styrene (ABS) welding	325
Wood flooring	100	Plastic cement welding	250
Rubber flooring	60	Adhesive primer for plastic	250
Subfloor	50	Contact adhesive	80
Ceramic tile	65	Special purpose contact adhesive	250
Vinyl composite tile and asphalt tile	50	Top & Trim Adhesive	250
Drywall and panel	50	Structural wood member adhesive	140
Cove base	50	Sheet-applied rubber lining operations	850
Multipurpose construction	70	**Substrate-Specific**	
Structural glazing	100	Metal to metal	30
Single-ply roof membrane	250	Plastic foams	50
Aerosol Adhesives	**VOC Content Limit (grams/liter less water)**	Porous materials (except wood)	50
General purpose mist spray	65% VOCs by weight	Wood	30
General Purpose web spray	55% VOCs by weight	Fiberglass	80
Special purpose aerosol adhesives (all types	70% VOCs by weight		
Sealant Applications	**VOC Content Limit (grams/liter less water)**	**Sealant Primer Applications**	**VOC Content Limit (grams/liter less water)**
Architectural	250	Architectural-Nonporous	250
Roadways	250	Architectural-Porous	775
Single-Ply Roof Material Installation/Repair	450	Other	750
Non-Membrane Roof Installation/Repair	300		
Other	420		

Source: South Coast Air Quality Management District Rule #1168, Rule Amendment date January 7,2005 and Aerosol Adhesives: Green Seal Standard for Commercial Adhesives GS-36 requirements in effect on October 19, 2000

Photo: Robb Williamson, ©DOE/NREL.

Bamboo is a grass that grows to full maturity in only 5 to 6 years making it a rapidly renewable resource.

Table 8-4
Reflectance Value of Wood

Wood Type	Reflectance
Maple	54%
Poplar	52%
White Pine	51%
Red Pine	49%
Oregon Pine	38%
Birch	35%
Beech	26%
Oak	23%
Cherry	20%

Source: Energy Design Guidelines for High Performance Schools, Temperate and Humid Climate

8.12.4.5 Partitions

Room partitions may be used in restrooms and throughout the office environment. Priority should be given to using salvaged or refurbished partitions before buying new. Manufactured partitions should pass GreenGuard standards.

Restroom partitions or dividers can be made from plastic, steel, wood, or even marble. Fort Hood requires that plastic and steel partitions contain at least 20% post-consumer or 40% post-industrial recycled content. If painting is required for steel partitions, factory painting is preferred. If other construction materials are used, they should be locally derived, salvaged, or certified (in the case of wood).

Office space partitions are recommended for their adaptability and life-cycle cost. These can be manufactured from a variety of materials such as steel, wood, vinyl-covered gypsum board, glass, and fabric. Recycled content and low-emitting materials are preferable. Numerous manufacturers offer modular systems that can easily be expanded or relocated to accommodate new floor plans as building size, spacing requirements, or function change.

Any paints or adhesives used in onsite construction at Fort Hood must meet VOC limits presented in Table 8-1 and Table 8-3, respectively. Also, see reflectance for paint in Table 8-2 and values for wood in Table 8-4. Furnishings such as office cubicles or partitions can have a significant impact on reflected light, so light-colored materials will be selected.

When selecting partitions consider the following:

- Full-height panels should be used only in areas with a specific need for increased privacy or separation, such as con-

Photo: Warren Gretz, ©DOE/NREL.

The National Renewable Energy Laboratory (NREL) Thermal Test Facility's open-space layout gives occupants the flexibility to easily rearrange workspaces as functional needs change.

Many carpet manufacturers off product take-back programs where used carpet tiles can be sent back to the company for reprocessing into new carpet

ference rooms, break areas, and certain private offices.

- Provide glass panels in corners and at windows to open up the space and allow natural light to filter into the center of the space.
- Provide access panels in the systems furniture to allow for communications connection.
- Panels should generally not exceed 66 inches in height in an open office area. Taller panels cut off air circulation, block views and natural light, and create a closed-in feeling.
- The location and use of taller panels must be carefully planned and coordinated because they can interfere with the proper functioning of air conditioning diffusers, fire sprinklers and smoke detectors, lighting fixtures, switches, thermostats, and sensors.
- Panels should not block service access to mechanical, electrical, or telephone equipment.
- Do not install panels in front of windows, as they will block natural light for the entire area. Panels installed perpendicular to windows should be installed at a window mullion.

8.12.4.6 Flooring

Carpet is one of the most common types of flooring used at Fort Hood. Carpet should be in the form of carpet tiles for all non-residential uses and should contain recycled content in the fibers, backing, and cushion. Carpets must meet the Carpet and Rug Institute's Green Label Indoor Air Quality Test Program (Figure 8-1). Preference should also be given to companies that offer take-back programs where used carpet tiles can be sent back to the company for reprocessing into new carpet.

Other carpet options include natural material made from plants, including grasses and cotton, or animal products such as wool.

Recycled-content carpet padding is widely available and comes in two primary types; one made from old carpet padding and another from reclaimed carpet fibers. Recycled-content carpet padding shall be used at Fort Hood.

Additional flooring options include hard flooring, resilient flooring, and wood. Table 8-5 provides a comparison of material characteristics for carpet, resilient flooring, and hard flooring. Fort Hood also encourages the use of locally manufactured or derived products flooring products. Fort Hood requires

any recycled content flooring material, including carpet, rubber, tile, or terrazzo, to contain at least 20% post-consumer or 40% post-industrial content.

If hardwood flooring is used, it must be Forest Stewardship Council (FSC)-certified or salvaged wood (Figure 8-1). The use of bamboo is preferred over hardwood flooring.

Any adhesives used in the onsite installation of the flooring systems at Fort Hood must be no- or low-VOC (see Table 8-3).

8.12.4.7 Ceiling Tiles

Ceiling tiles are available with up to 95% recycled content. Fort Hood requires that all new ceiling tiles contain at least 20% post-consumer or 40% post-industrial recycled content. Fort Hood requires high-humidity ceiling tiles designated as RH90. A mineral fiber backing is required. This is to provide non-hygroscopic materials in the facility to minimize the possibility of moisture retainage and mildew.

Additionally, ceiling tiles should be recyclable (or salvageable) when replaced or discarded. Some companies offer product take-back programs similar to carpet manufacturers. Manufacturers that offer such programs should be given preference.

Ceilings are the most important interior light-reflecting surface. High reflectance ceiling tiles with 0.85 or greater reflectance values should be specified.

Any adhesives used to install ceiling tiles at Fort Hood must be no- or low-VOC (see Table 8-3).

Table 8-5 CHARACTERISTICS of FLOORING MATERIALS							
	CARPET		RESILIENT FLOORING		HARD FLOORING		
Characteristics	Broadloom Carpet	Vinyl cushion tufted textile (VCTT)	Linoleum	Vinyl composition tile (VCT) and sheet flooring	Terrazzo	Ceramic Tile	Concrete
Effects on IAQ							
Installation requires VOC emitting coatings and adhesives	U	D Peel-and-stick dry adhesive	A Low VOC adhesive and sealer available	U	Depends on type[i]	Adhesives emit very low VOC levels	No adhesives; some sealers emit VOCs, but best ones do not.[ii]
Material itself emits VOCs	Depends on carpet	D Does not emit VOCs	U Linseed oil may offgas. Odor may persist long after installation.	U	Depends on type. Epoxy emits toxic VOCs during installation, and possibly after; cementitious does not	Depends on type. Portland cement grout and mortar do not support mold and mildew; epoxy systems might	D No VOCs
Maintenance requires VOC emitting products	A No, but unrinsed deter-gent may kick up irritating particles	A No, but unrinsed detergent may kick up irritating particles	U/A buffing compound may emit VOCs; use low-VOC alternative	U some require sealants and waxes; VCT waxing/stripping requires school to be unoccupied for at least 48 hours.	A No, if use water-based sealer. No waxing or stripping. Wash with neutral detergent weekly; seal annually or less	No. Clean with neutral cleaner and water	Maintain with water and mild detergent
Allows water in a room to penetrate down to subfloor, supporting mold and mildew	U Is common problem with carpet	D Backing is impermeable to water	U Water can pene-trate seams; sealer may reduce this	U VCT seams allow water through; sealer may reduce this. VCT itself is impermeable	D Does not allow water to penetrate	U Water can penetrate some tiles and grouts; sealer may reduce this	Concrete is porous; sealer should pre-vent penetration, though boundary to wall may allow it
Allows moisture (vapor) to escape *from* slab, pre-venting water build-up that can damage buildings and sup-port mold/ mildew[iii]	U Allows escape, but supports mold and mildew if subfloor gets wet	U Impermeable backing does not allow vapor to escape	U Even if moisture escapes, linoleum itself supports mold and mildew if subfloor gets wet	U Impermeable; water can pool beneath it and pop tiles	D Cementitious terrazzo (and sealers) allow moisture out; epoxy does not	D Tile and grout can both be porous or non-porous;[iv] Sealer is breathable	D Concrete and sealer are somewhat breathable

Table 8-5
CHARACTERISTICS of FLOORING MATERIALS

Characteristics	CARPET		RESILIENT FLOORING		HARD FLOORING		
	Broadloom Carpet	Vinyl cushion tufted textile (VCTT)	Linoleum	Vinyl composition tile (VCT) and sheet flooring	Terrazzo	Ceramic Tile	Concrete
Cost / maintenance considerations							
Durability	2-15 yrs	20+ years	High (data not available)	High (data not available)	40-80 years	40-80 years	Very high (data not available)
Up-front cost/ Lifetime cost	Low/ High	Higher than broadloom carpet/ High	Low/ Medium	Varies/ Medium	High/ Low	High/ Low	High/ Low
Maintenance cost	Highest	High	Medium	Medium	Low	Low	Low
Easy to clean			D	D	D	D	D
Quality of the room							
Controls noise	D	D	A	A	U	U	U
Effect on room light	Reduces glare and reflection	Reduces glare and reflection	Reflective surface enhances daylight	Reflective surface enhances daylight	Light reduction depends on choice of color	Glare reduction depends on choice of color and texture	Glare reduction depends on choice of color and texture[v]
Comfort and Safety							
Comfortable to sit, stand or fall on	D	D	A comfortable to stand	A comfortable to stand	U Very hard to stand, sit or fall on	U Very hard to stand, sit or fall on	U Very hard to stand, sit or fall on
Limits Slips and fall	D	D			Sealer helps reduce them	Depends on type[vi]	D especially if textured
Environmental considerations[vii]	Poor	Poor	Medium	Poor	Medium	Medium	Medium

Key:
A Acceptable attribute
D Desirable attribute
U Undesirable attribute

VOC = Volatile organic compounds.

Source: This document was produced by Frances Gilmore, MS, for the Asthma Regional Council of New England:. www.asthmaregionalcouncil.org.

Notes:
[1] Most cementitious types use no adhesive or primer. Non-VOC emitting primers (for epoxy terrazzo) or adhesives (for some cementitious type) are available.

Table 8-5
CHARACTERISTICS of FLOORING MATERIALS

Characteristics	CARPET		RESILIENT FLOORING		HARD FLOORING		
	Broadloom Carpet	Vinyl cushion tufted textile (VCTT)	Linoleum	Vinyl composition tile (VCT) and sheet flooring	Terrazzo	Ceramic Tile	Concrete

terrazzo.

[1] There are two types of sealers: penetrating ones, and surface coatings that form a membrane. Penetrating ones such as sodium silicates are recommended, a permanent as they absorb into the concrete. Membrane sealers may contain acrylics, urethanes or epoxies, which present a VOC problem to installers, may ye can become disbonded if there is water from the slab. The sealer controls dust from concrete, prevents stains and makes the surface of the concrete 50% strc

[1] The issue of water and the slab is complex and beyond the scope of this factsheet. If major problems exist, consult a good industrial hygiene and/or architectu

[1] Quarry tile is porous and allows moisture to escape (breathe) from slab, porcelain doesn't breathe at all, other ceramic tiles breathe a little; cementitious grout entering it, though sealer breathes, allow evaporation from slab; epoxy grout is non-porous. All tile allows some water penetration from the surface (except pc considered a waterproofing system.

[1] If the floor is the slab, color is applied by acid-staining the slab. Only in new construction can textures be stamped in. In old buildings with damaged or beat-u concrete) can be added, and can be stained and textured.

[1] Ceramic tile can have grit added by manufacturer to create non-slip surface. The grit acts like a walk-off mat to abrade dirt from shoes. Quarry tile can be tex rough, non-slip surface. Sealer adds non-slip quality to any tile.

[1] Includes: harmfulness to workers in manufacturing, contains recyclable material, made from sustainable resources, low in embodied energy, and recyclable.

A note on sources:

Where possible, information was obtained from neutral parties, such as state health departments and architectural firms with school experience. When such infor associations were consulted, and manufacturers only as a last resort.

8.12.4.8 Doors

Interior doors are defined as doors that do not separate conditioned space and do not require good thermal performance. Interior doors provide an opportunity for using recycled-content materials and certified wood. Molded hardboard interior doors are a good use of lumber mill waste shavings. Salvaged doors are also an option. Urea formaldehyde is a binding agent used in the production of wood doors that should be avoided. Low-emitting products that are made with phenol formaldehyde, or are formaldehyde free, are preferred.

Any paints or adhesives used in onsite construction at Fort Hood must meet VOC limits presented in Table 8-1 and Table 8-3, respectively.

8.12.4.9 Additional Resources

Many government and commercial resources, including those listed in Figure 8-1, are available to help find and purchase sustainable building products. Additional resources can be found in the GreenSpec directory at http://www.buildinggreen.com. Contact DPW Environmental: 254-287-9736 for further help in identifying sustainable building products for use at Fort Hood.

8.12.5 SYSTEMS FURNITURE DESIGN GUIDELINES

Furnishings are elements added to a building interior for utility or decoration following construction. These include furniture such as chairs, desks, sofas, and tables and also cabinetry, window treatments, signage, accessories, art, and plants. When selecting furnishings for an interior environment, care should be taken to include their design as an integral part of the overall concept and to ensure coherence among architecture, materials, furniture, art, and signage. In addition, when selecting furnishings, all materials and additives should be considered in terms of their sustainability. The following subsections discuss the various furnishings components and provide guidance on the programming, acquisition, functionality, and maintenance of the various components.

Furniture. Furniture systems are a wide range of furniture types comprised of components to create a custom-designed work environment to meet specific functional needs. Furniture can include seating, tables, accessories, and case goods. Case goods are furniture elements, including desks credenzas, file cabinets, and other items that are constructed from box-like components. Case goods fall under two major categories: conventional and modular. Conventional case goods are delivered as pre-

assembled, ready-to-use products. Modular case goods are manufactured as separate pieces that may be grouped into a number of different arrangements.

Furniture is typically constructed using a combination of different materials, including but not limited to steel, wood, particle/fiberboard, plastic, adhesives, and fabric. Priority should be given to using salvaged or refurbished furnishings before buying new. Fort Hood encourages the use of products that contain recycled content and are themselves recyclable. Wood components should be certified or rapidly renewable. Indoor air quality issues are a primary concern with furniture manufacture. Manufactured partitions should pass GreenGuard standards.

Systems Furniture. Systems furniture is ergonomically designed to meet a variety of conditions and requirements. Careful planning is critical during the initial stages of designing new systems furniture layouts. Power and communications requirements must be determined and planned so they are available at the locations where they are needed. Provisions for furniture systems' electrical and data requirements must be made a part of the construction documents. See Sections 8.14.7.1 and 8.14.7.2 for interior design standards for electrical and communications wiring, respectively. Surface-mounted conduit and power poles are unsightly and should be avoided.

For a detailed discussion on the Army Interior Design Process (planning and programming, procurement, and design services) and Planning for Administrative Work Environments (data collection, analysis, space planning, layout, design coordination, documentation, and implementation) see UFC 3-120-02AN, Design Guide for Interiors.

Budgeting for Furniture Systems. Furniture systems can represent a significant percentage of a project. Furniture systems are Operations and Maintenance (O&M) funded and should be included in the project scope along with such items as built-in casework. Furniture systems are listed on DD Form 1391 as a non-add entry in Block 9 for "Equipment Provided for Other Appropriations." In Block 12b, the furniture systems should be indicated as an O&M-funded item. Also provide the fiscal year the funds are requested, and the line item cost. Accessories can account for a significant portion of the furniture systems package and should be budgeted with the basic system components.

When designing an interior furniture system, the following should be considered:

- During the initial planning of new systems furniture, consider the condition and appearance of existing paint, wall coverings, carpet, and base of the area.

- When planning the location of office equipment and break areas, do not place heat-generating devices, such as coffee makers or copiers, near a thermostat.
- Circulation paths should be clear and easy to navigate.
- Topics that should be considered when designing new systems furniture layouts include:
  - Function of the office;
  - Adjacencies of personnel and activities;
  - Meeting and conference room requirements;
  - Individual storage needs;
  - Areas for common use office equipment such as the copier and fax;
  - Reception area with waiting and guest seating space;
  - Special furniture or needs of a particular office, such as drafting tables or extra storage space;
  - Communications equipment;
  - Task lighting, daylight, and ambient lighting;
  - Special security requirements;
  - Budget constraints;
  - Flexibility to allow future changes;
  - Schedules of design, delivery, and installation;
  - Air conditioning; and
  - Acoustic performance requirements.
- Color and Texture:

- To maintain a professional atmosphere, the style and types of systems furniture should be consistent throughout the area.
- The materials and colors of the panels and chairs should be durable. They should be heavy-duty and stain-resistant.
- The fabric on the systems furniture should harmonize with the overall building color scheme.

8.12.5.1 Window Treatments

Window treatments must: (1) complement and support the interior design of a space, and (2) be selected for consistency with the daylighting design of the building. Window treatments provide privacy, light and sun control, reduced energy consumption, and decreased sound transmission. They also conceal architectural defects, or change the apparent size, shape, and character of a room. Consider the following factors when making a window treatment selection:

- Light control requirements;
- Architectural style; and
- Historical context.

When using a fabric, consider that:

- Sheer or semi-sheer fabrics provide minimum privacy, shade, and energy conservation;
- Heavy, opaque fabric and hard treatments should be used only where total light exclusion is required; and
- Full, soft treatments absorb more sound than hard treatments.

8.12.5.2 Signage

Signage may be informational, directional, or regulatory. Informational signage includes room or area labels, bulletin boards, menus, artwork descriptions, and emergency information. Directional signage, such as entry directories, directional arrows, and maps, guides traffic flow and provides orientation.

The purpose of regulatory signage is control; it provides warnings and emergency instructions, as well as indicates prohibitions and use restrictions.

Interior signage is covered in detail in Technical Manual (TM) 5-807-10, *Signage*. The manual includes graphics for the following: directional, identification signs, information, and pictograms.

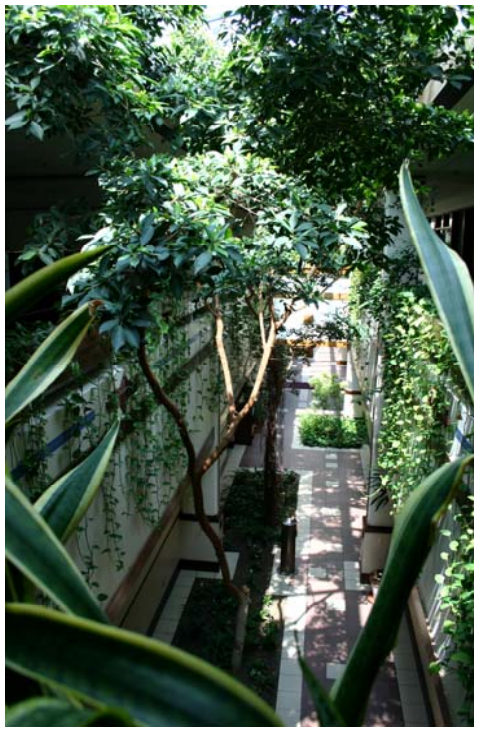
8.12.5.3 Accessories

Accessories may be either functional or decorative. Whatever the purpose, accessories make a room appear inviting and personal.

Functional Accessories. These accessories include letter trays, coat racks, lamps, product displays, magazine racks, brochure racks, and message boards. This group of accessories should be selected for utilitarian aspects, as well as aesthetic qualities that may contribute to the total design concept. Repetitive elements can act as unifiers and help tie the accessories to the design theme.

Decorative Accessories. Decorative accessories are objects such as artwork and plants.

- **Art.** Display and positioning of artwork in an interior space involves many important decisions. The designer must work closely with the user to determine placements that are satisfactory for both functional and visual composition. Some factors to consider regarding the use of artwork are:
  - Quality (posters, prints, original art);
  - Subject matter;
  - Medium (photography, paper, oil, etc.);
  - Size;
  - Placement;
  - Method of display (permanent collection or rotating program);
  - Lighting; and
  - Integration with design scheme.



Where outdoor views are not aesthetically pleasing, available, or feasible, other means of providing a connection to the natural world should be considered such as the incorporation of indoor landscapes and plants.

- **Plants.** Plants add color, texture, and variety of form and shape to the interior. They bring a natural element to an interior space and are used for focal points, screen, and for psychological effect. Increasingly, plants are being incorporated into the interior environment for the health and well-being of the user, as well as enrichment of the space.

  When selecting plants, their light, water, and temperature needs, continuing care requirements, and ease of replacement must all be considered. Both the amount and types of light (direct or indirect; daylight, fluorescent, or incandescent) the space has also must be considered. Plants should not be positioned such that their location presents a problem when watering.

  Detailed information on interior planting, including design considerations (light requirements, temperature, atmosphere considerations, and planters), plant maintenance, and a listing of recommended plants, can be found in the *USAF Landscape Design Guide*, *Chapter 20* "Interior Planting" in the Air Force *Interior Design Guides*, Chapter 8, "Interior Planting."

8.12.5.4 INSTALLATION FURNISHINGS STANDARDS

A. Community Support

Community support facilities encompass a wide variety of buildings with various functional uses. The interior design criteria for the general building types in this zone are provided below.

A.1 Administrative Buildings, including Corps Headquarters, Brigade/Battalion Headquarters, and Company Operations

Administrative buildings housing command operations should convey a spirit of military pride and tradition. Interior furnishings should be durable and high quality reflecting the level of importance of the operations and personnel housed in the building. Specific needs for offices depend on end-users' needs and different levels of rank. The following is a good guideline for basic administrative needs. These guidelines can be expanded on within reason (For example: desk for commander is actually an executive desk with credenza). All furniture should be ergonomic in design.

- desk
- task chair

- 1 guest chair (at least)
- 1 file cabinet (at least)
- white board (marker board)

A neutral color scheme should be used, with unit colors used as accents in upholstery fabrics, window treatments, artwork, and accessories.

- **Window Treatments.** Depending on room designation, offices should use roller shades using a variety of materials, micromesh being the most popular. The density of the mesh can control the lighting level from outside, so lower percentage mesh would work well in rooms that will be used for projection presentations. All window treatments must take into consideration the daylighting design element for the building.
- **Accessories.** Accessories should be kept to a minimum and relative to the work environment. Awards, citations, and certificates should be displayed in a professional manner. Personal items should be kept to a minimum. The office is not an appropriate place to display collections of a large size. Likewise, photographs should be displayed in a frame of some sort and quantities should be kept to a minimum.
- **Art.** Art can be a multitude of things from framed pieces to company photos and citations. As long as a standard system of display is selected (Example: black-stained wood frames) and maintained, art should be encouraged.
- **Plants**. Interior landscaping should be left to a reasonable amount and left to the individual due to allergies. A standard for containers should be established and carried throughout the space. Either live or professional silk displays are appropriate and should be maintained.
- **Signage**. Directional signage should be clear and precise, and should blend with the interior of the building.

A.2 Institutional Buildings, including Hospitals, Dental Clinics, Training Centers, Dining Facilities

The unique role of each building in this category should be conveyed by the building's interior, which in turn should correspond with the building activity. Interiors should be neutral with accent colors that

reflect the nature of the individual activity spaces within the building. For example, medical facilities should have a soft, soothing interior that uses blues and greens. Dining facilities should be bright and cheerful and incorporate abundant natural daylight.

Institutional finishes and furnishings should include easily cleaned fabrics, mar-resistant surfaces, and durable construction. Window treatments should be blinds or shades, but must consider the daylighting design element for the building. Signage is generally very important in large complex buildings like hospitals, and should be clear, easily readable, and displayed in a prominent location that can be seen from some distance away.

B. Retail and Commercial

Each commercial building will have its own unique feel; however, they all should invoke the overall theme of Fort Hood by incorporating the materials, colors, and/or other decorative and display items used elsewhere on the installation. Interiors should be clean, bright, and airy with abundant natural daylight. Color palettes can vary from bright to subdued, depending on the nature of the activities in the building. Interior furnishings should be durable, easily cleaned, and maintained. Floors should be slip-resistant to provide a high level of safety.

B.1 Troop Housing

Barracks should be warm and inviting, invoking a feeling of home. Colors in private living areas should be light and neutral, enabling residents to personalize the space to some degree. Unit colors and displays should be emphasized in common areas to invoke a feeling of unit pride. Depending on the size of the windows, either 1-inch or 2-inch metal blinds are appropriate; however, daylighting design element for the building must be considered. All finishes and furnishings should be durable and easy to maintain. Modular, contemporary furnishings should be considered.

Specific furnishings depend on end-users' needs and different levels of rank; however, the following is a good guideline to basic barrack needs. These guidelines can be expanded on within reason.

- bed
- nightstand
- dresser

- lamp
- desk
- desk chair

If there is a service area, these items also are included:

- table
- chairs

C. Family Housing

Family housing should be designed to allow residents to personalize the space and invoke a true feeling of home. Colors should be white or neutral. Furnishings should be lighter construction and smaller in scale to fit smaller-scale residential spaces than those used in more public spaces.

D. Industrial and Warehouse

Interior finishes and furnishings in industrial spaces should be durable, and easily cleaned and maintained. Furnishings in office spaces should be modular components that can be moved easily to accommodate changes in function. Colors schemes should be light and neutral. Abundant daylight should be incorporated into high bay areas.

E. Recreation and Open Space

Recreation buildings can be less formal and invoke a relaxed, fun feeling. Use of natural materials should be emphasized in both the exterior and interior, such as local wood and stone. Interior furnishings should be durable and easily cleaned and maintained. Color schemes should be muted earth tones.

8.12.6 Humidity Considerations for Interior Furnishing and Building Materials

Fort Hood prefers the use of non-hygroscopic finishes and ceiling tile suitable for use in a 90% humidity environment to the greatest extent possible

8.12.7 Unified Facilities Guide Specifications

For Unified Facilities Guide Specifications for furnishings, see the "Division 12 – Furnishings" section on the Construction Criteria Base website.

8.12.8 Installation Furnishings Standards

Installation furnishings standards are found in Appendix C, Interior Furnishings Standards of this IDG.

8.12.9 Interior Operations and Appearance Policies

To preserve the quality of facilities, operations policy is set between the user and the installation management and an appearance policy can be implemented. The user is responsible for preserving the visual appearance of the facility, and installation management is responsible for providing maintenance needed to preserve facility quality. Interior operations policies address the following issues.

8.12.10 References and Resources Related to Building Interior Components

- *Air Force Interior Design Guides*, http://www.afcee.brooks.af.mil/dc/dcd/interior/intdespu.asp
- AR 405-70, *Utilization of Real Property*, http://www.usapa.army.mil/pdffiles/r405_70.pdf
- Bay Area Air Quality Management District Regulation 8, Rule 51, http://www.baaqmd.gov/dst/regulations/rg0851.pdf
- Carpet and Rug Institute's Green Label Indoor Air Quality Test Program, http://www.carpet-rug.com/drill_down_2.cfm?page=8&sub=6
- Department of Defense (DD) Form 1391, Military Construction Project Data, http://www.hnd.usace.army.mil/pao/FactShtsFY04/dd1391-04.pdf
- Energy Design Guidelines for High Performance Schools, Temperate and Humid Climate, http://www.nrel.gov/docs/fy02osti/29105.pdf
- ER 1110-345-122, *Engineering and Design, Interior Design*, http://www.usace.army.mil/inet/usace-docs/eng-regs/er1110-345-122/entire.pdf

- Forest Stewardship Council (FSC)-certified products, http://www.fsc.org/en/whats_new/fsc_certificates/fsc_database
- Green Seal, http://www.greenseal.org/
- GreenGuard Environmental Institute, http://www.greenguard.org/DesktopDefault.aspx?tabindex=0&tabid=1 and GreenGuard standards, http://www.greenguard.org/DesktopDefault.aspx?tabindex=3&tabid=16
- GreenSpec directory, http://www.buildinggreen.com/menus/index.cfm
- Military Handbook 1191, *Medical Military Construction Program Facilities Design and Construction Criteria*, Unified Facilities Criteria (UFC) 4-510-01, Design: Medical Military Facilities.
- TI 801-02, *Family Housing*, http://www.hnd.usace.army.mil/techinfo/ti/801-02/famhouse.htm
- TM 5-807-10, *Signage*, http://www.usace.army.mil/inet/usace-docs/armytm/tm5-807-10/
- U.S. Army Corps of Engineers, *UFC 3-120-02AN, Design Guide for Interiors*, http://www.hnd.usace.army.mil/techinfo/UFC/UFC3-120-02AN/UFC3-120-02AN.pdf
- Uniform Federal Accessibility Standards UFAS 4.1.4 (2), *Military Exclusions*, http://www.access-board.gov/ufas/ufas-html/ufas.htm
- Unified Facilities Guide Specifications, "Division 12 – Furnishings", downloadable at http://www.wbdg.org/ccb/browse_org.php?o=70
- *USAF Landscape Design Guide*, http://www.afcee.brooks.af.mil/dc/dcd/land/ldg/index.html

8.13 EXTERIOR BUILDING MATERIALS, COLOR AND COMPONENTS

Building materials make a major contribution to the character of a military installation. Building materials have both a visual aspect related to the scale, color, and texture, and a component aspect related to material sustainability and overall character to installation applications. Therefore, a key objective of the Fort Hood IDG is to provide a sense of legibility, uniformity and order to Fort Hood's built environment through recommendations that provided for careful design and massing, and sensitive

use of color, building material, detailing and embellishment. For example, within the Main Cantonment, there should be visual differentiation between the three main division footprints (1st Cavalry Division, 4th Infantry Division and 13th Sustainment Command [Expeditionary] Division). This can be accomplished through the use of color. Additionally, a building's character, its look and feel, should be a function of its use and defined according to its Facility Category Code. In that Fort Hood is both a ground and air training center of excellence, an architectural language should be developed that visually distinguishes buildings associated with motor pools (for land-based equipment) from those associated with hangars (for aircraft and equipment). All of these architectural distinctions should be made only from a ground-level perspective. From an aerial perspective (plan-view), all buildings should look similar, regarding level of importance.

8.13.1 Visual Exterior Building Materials and Colors

A limited palette of durable, low-maintenance materials should be used that – while encouraging a variety of expression – provides a cohesive and consistent architectural character through the installation and within each visual zone. Materials should reflect the function of a building and its hierarchy within the installation and should be compatible with the character of a visual zone.

Appendix E provides architectural recommendations for each visual zones. The recommendations provided photographic examples taken from Fort Hood that are designed to bring a greater sense of legibility, uniformity and order to Fort Hood's built environment. Exterior Material Charts are also provided in Appendix E. These charts provide recommendations for material types, color for individual building design elements by Facility category Code (e.g., roofs, walls, fenestrations, etc.).

Color is closely linked to the appropriate selection of exterior building materials and is a critical design element in relating adjacent buildings and creating a compatible visual environment within an installation. Color recommendations for all facilities within the visual zones shall adhere to Pantone color charts and specifications found within Appendix F of the Installation Design Guide.

Fort Hood requires that all exterior colors for each exterior component of the building project to be identified and shown on a color board. Factory-applied finishes are required on all exterior metal components.

Any necessary color changes related to painting will be implemented during normally scheduled paint cycles. When historic buildings or structures are repainted, match the existing colors or colors that can

be documented to have been used on that building and create compatible adjacencies to surrounding structures.

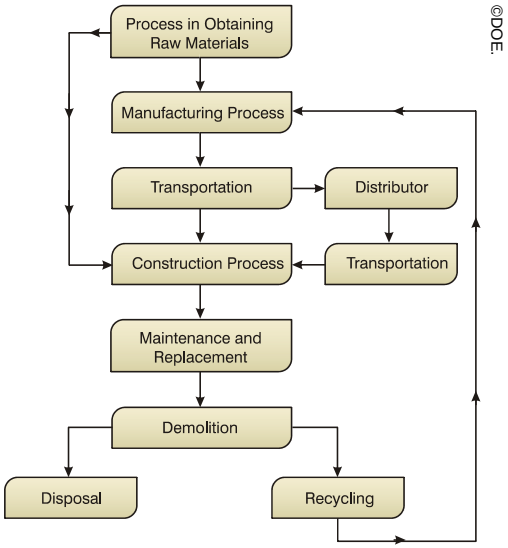
8.13.2 Exterior Building Components

The use of durable, attractive, and environmentally responsible building materials is a key element of Fort Hood's sustainable building effort. The Fort is committed to the use of sustainable building products and materials in all future new construction and renovation projects. The benefits of these types of products and materials meet Fort Hood's 25-Year Sustainable Goals of using sustainable products.

All materials should be considered in terms of their embodied energy and characteristics of toxicity, potential for off-gassing, finish, and maintenance requirements. Designers are encouraged to use indigenous materials and to consider the practical and effective use of emerging technologies. The use of regional materials also supports the regional economy, helping to strengthen the local community and contributing to a higher quality of life.

Building material choices are important in sustainable design because of the extensive network of extraction, processing, and transportation steps required in delivering a final product to the building site. One of the most effective strategies for minimizing the environmental impacts of material use is to reuse existing buildings. Rehabilitation of existing building shells and non-shell components should be considered first as this reduces environmental impacts associated with the production and delivery of new building products, as well as diverts waste from landfills. Reuse of an existing building structure or foundation also minimizes disturbance of existing vegetation and wildlife habitat. When choosing new materials, their future recyclability or reusability should be assessed.

Specific building materials and their use at Fort Hood are discussed below. Fort Hood requires that all exterior colors for each exterior component of the building project to be identified and shown on a color board. Factory-applied finishes are required on all exterior metal components.



Total Embodied Energy Diagram

One of the most effective strategies for minimizing the environmental impacts of material use is to reuse existing buildings.

8.13.2.1 Architectural Elements

The building materials discussed in this section must be consistent with the aesthetics and architectural look of the visual zone (Appendices J and K) where the project activity is to occur. The purpose of this section is to guide the designer in the required use of sustainable material for buildings at Fort Hood.

The visual aspect challenge is to ensure a cohesive and consistent architectural character throughout the installation while blending the new with the old.

Factory-applied finishes are required on all exterior metal components.

Fenestration Product. All metal members of the fenestration product, including doors and windows listed below, that are exposed to interior and exterior air must incorporate a thermal break.

Doors. Exterior doors shall have infiltration rates not exceeding 0.3 cubic feet per minute per square foot (cfm/ft^2) of window area, 0.3 cfm/ft^2 of door area for residential doors, 0.3 cfm/ft^2 of door area for nonresidential single doors (swinging and sliding), and 1.0 cfm/ft^2 for nonresidential double door (swinging) when tested according to NFRC-400 or ASTM E 283 at a pressure differential of 75 pascals or 1.57 pounds per square foot.

Exterior doors (and frames) that separate conditioned space constructed of steel will be of recycled content and contain insulating core material that does not contribute to ozone depletion (i.e., does not use chlorofluorocarbon [CFC] or hydro-chlorofluorocarbon [HCFC]). Rigid foam plastics and fiberglass are typically used as insulating cores. In the case of foam plastics, expanded polystyrene (EPS) is preferable to extruded polystyrene and polyurethane because of the use of ozone-depleting chemicals as blowing agents. U-factor for a steel, foam core exterior door shall be less than or equal to 0.35 British thermal units per hour per square foot per degree Fahrenheit (Btu/hr-ft^2-F). Finishes on metal doors should be applied at the factory and consist of a no- or low-VOC paint that is cured to eliminate VOC emissions after installation. Solid wood exterior doors that are certified as being from a sustainable managed forest may also be used. For a solid wood exterior door, the required U-factor is less than or equal to 0.40 Btu/hr-ft^2-F. Weather-stripping along the top, jambs, and bottom sweeps is required to minimize air infiltration around exterior doors.

All glass in exterior doors shall have a U-factor or energy efficiency rating less than or equal to 0.65 Btu/hr-ft^2-F and have 15% recycled content.

For additional information related to overhead coiling door construction requirements, contact the DPW.

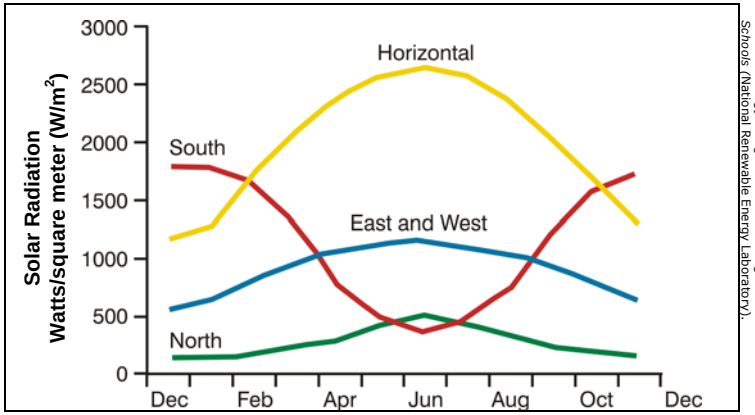
Overhead Coiling Doors

Several local changes to the specifications have occurred to provide a better motorized roll up door. Problems related to this system include: light gauged slat material that allows the wind locks to rip out; insufficient spacing of the wind-locks; motors that are not mounted correctly; insufficient space

to mount the motor; a flat surface on the inside of the opening is not provided on the head and jambs of the door opening; and poor installation and non-existent warranty repairs.

The following specifications are required when selecting and installing overhead coiling doors:

Manufacturer:
The overhead coiling door shall be the product of a recognized overhead coiling door manufacturer who has been in the practice of manufacturing overhead coiling doors for a period of not less than 3 years and has been involved in at least 5 projects similar in size and complexity to this project.



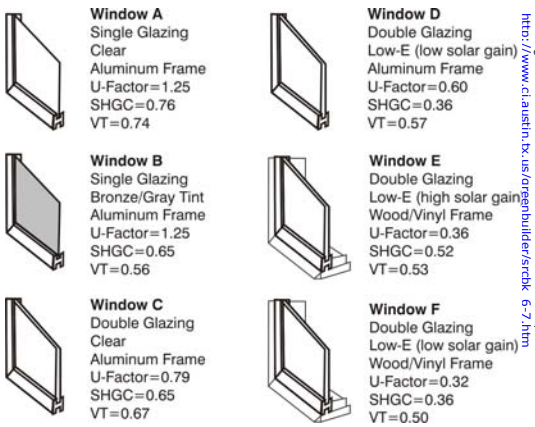
Comparison of Window Orientations – 32° Latitude

Source: *Energy Design Guidelines for High Performance Schools* (National Renewable Energy Laboratory).

The amount of solar radiation striking windows varies with the surface orientation.

Manufacturer's Representative:
A representative of the overhead coiling door manufacturer who is familiar with the design of the doors supplied and experienced in the installation of overhead ceiling doors similar in size to the ones required under this contract shall be present at the jobsite during the installation of the overhead coiling doors to assure that the door installation meets the specified and manufacturer's installation requirements. The manufacturer's representative shall be either an employee of the manufacturer with at least two years experience in the installation of overhead coiling doors or an employee of an independent installer that is certified by the manufacturer and shall have two years experience installing similar overhead coiling doors.

Wind Load Requirements:
Doors and components shall be designed to withstand the minimum design wind load of 33 pounds per square foot. Doors shall be constructed to sustain a superimposed load, both inward and outward, equal to 1-1/2 time the minimum wind load. In addition to the static test requirements above, the doors and components shall be designed to be operable and fully open and close under a 20-psf-wind load both inward and outward.



Source: Austin Energy Green Building Program, 2003, *Sustainable Building Sourcebook: Materials: Doors and Windows*, http://www.ci.austin.tx.us/greenbuilder/srcbk 6-7.htm

Varying the specifications for a window can have a significant effect on its overall energy performance. Fort Hood has minimum specifications for their windows that are appropriate for the geographical region.

Finish

Slats and bottom bars of exterior doors shall be hot dipped galvanized; shop primed and has a factory finish. The factory finish shall be an electrostatic thermal set, polyester powder coating.

Windows. Windows are a critical design component of a sustainable building envelope. They affect the building's thermal performance as well as provide natural daylight to enter the structure. They also affect time orientation, access to outdoor views, the possibility of natural ventilation, and emergency egress. The hot summers of Fort Hood, coupled with the abundant sunshine received in the region, make solar control of all fenestration an important design consideration. Uncontrolled solar gain results in high cooling loads, excessive illumination, and glare. The following discussion provides guidance on performance measures for windows for use by Fort Hood.

Fort Hood requires view windows for all new Fort Hood facilities to be high-performance windows consisting of double-pane and low-emissive (low-e) glass. Window glass shall have 15% recycled content and any aluminum component of the window shall be of 95% recycled aluminum. Fort Hood requires a U-factor, or energy efficiency rating for windows to be less than or equal to 0.65 (Btu/hr-ft^2-F; for skylights the U-factor shall be less than or equal to 0.75 Btu/hr-ft^2-F). The lower the U-factor, the greater the window's resistance to heat flow and the better its insulating value.

A specific solar heat gain coefficient (SHGC) is another window characteristic specification for Fort Hood. The lower the SHGC, the better a product is at blocking unwanted heat gain. In spaces dominated by cooling loads, select glass (including skylights) with a low SHGC, i.e., less than or equal to 0.40, possibly with a reflective outer surface. This is particularly important on east and west facades. North-facing windows and windows shaded by overhangs on the south façade should have higher SHGCs.

Other considerations when selecting windows include visible transmittance (VT) and operability. Windows with a higher VT should be selected to maximize daylighting and views. A VT of not less than 0.50 is recommended. A window's air infiltration rate shall not exceed 0.3 cfm/ft^2.

Operable windows provide building occupants with a connection to the outdoors and can serve to provide additional natural ventilation (under appropriate outdoor conditions) if the mechanical systems are shut down because of problems or servicing. The ventilation characteristics of a window that provides a modest connection to the outdoors are different from a window that can provide a portion of the cooling requirements for the interior space. The ventilation function of an operable sash must be incorporated into the total fenestration design. It may not be feasible or necessary to make all windows operable in office or commercial buildings. A small awning or sliding window below a fixed window can provide the desired effect. All operable windows must have appropriate locks and security gates to prevent intruders and falls from heights. Operable windows should not be installed on the perimeter walls of buildings that do not meet the required minimum standoff distance.

Window Selection Considerations		
Application	**Exposure**	**Type**
View Glass (Non Daylight Apertures)	South	Clear Double Low-e
	North	Clear Double Low-e
	East/West, Unshaded	Tinted Double Low-e
	East/West, Shaded	Clear Double Low-e
Windows Above lightshelves	South	Clear Double or Clear Double with Argon
High Windows-Above View Glass	North	Clear Double or Clear Double with Argon
Roof Monitors	South	Clear Double or Clear Double with Argon
The intended application and exposure determines appropriate window selection.		

Operable windows provide building occupants with a connection to the outdoors and can provide natural ventilation.

Frame materials should have recycled content, be durable, and compatible with Fort Hood's climate and architectural preferences. Select recycled content aluminum or composite frames. If using aluminum frames, a thermal break must be provided. Wood frames should be constructed of certified wood. Pre-finished aluminum-clad wood windows are also available. These windows offer the same thermal properties as wood windows without the maintenance issues of wood windows. Another frame and sash option is composite recycled wood fiber and vinyl composition frame and sash material. This family of materials offers strength and insulation value comparable to wood components without wood's maintenance requirements.

All windows must be designed to prevent the roosting and nesting of birds. Window placement is another key part of the overall energy efficiency strategy for a project. East-facing windows should be minimized and west-facing windows should be eliminated or shaded by porch roofs, overhangs, or other structures. This will avoid heat build-up in the morning and afternoon when the sun is low enough to shine directly into the windows. South-facing windows should be shaded with exterior solar

control devices or by roof overhangs or awnings sized to respond to solar geometries at the site. North-facing windows should be maximized for daylighting purposes.

Any paints or adhesives/sealants used in onsite construction at Fort Hood must meet VOC limits presented in Table 8-1 and Table 8-3, respectively.

Roofing. Roofs are especially vulnerable to solar gain in summer and heat loss in winter. Dark, non-reflective roofing surfaces create heat island effects by absorbing energy from the sun and radiating it as heat. The following discussion provides guidance on the type of roofs to be specified for use at Fort Hood.

Fort Hood requires the use of high albedo, i.e., high-reflectance and high emissivity, roofs (often referred to as "cool roofs") that can reflect heat instead of absorbing it. For a low-slope roof, the initial solar reflectance should be at least 0.65 (with a three-year aged reflectance of at least 0.50); steep-sloped roofs should have an initial solar reflectance of at least 0.25 (with a three-year reflectance of at least 0.15). Construction of flat roofs is not preferred or recommended for Fort Hood and roof penetration shall be minimized.

Recycled content must also be considered when selecting roofing materials. Most roofing materials, such as metal, rubber (e.g., EcoStar™ Products), and composite materials, contain high percentages of recycled material. Certain asphalt or composition shingles contain recycled, mixed paper in their base, and some installations use reclaimed minerals in the surface aggregate. If considering rainwater catchments or harvesting (see Section 8.14.4), metal and clay tiles are good surfaces for this option. White, glazed, clay tiles make an additional contribution to reflecting heat from the building.

As compatible with the building type, ridge vents with air chutes starting at the soffit vents shall be used for attic ventilation. Attic ventilation is the traditional way of controlling temperature and moisture in an attic. A vented attic is cooler on a hot day, and on a cold day venting maintains uniform roof sheathing temperature. Ridge vents are not approved for use in vehicle maintenance shops and warehouse.

Standing Seam Metal Roof Systems

For standing seam metal roofing systems:

- Provide metal decking over bar joists with 3-1/2 inch or 4-1/2 inch zee purlins screw attached through the metal decking to the bar joist. The standing seam roof will be attached to the zee purlins. Rigid building insulation will be inserted below the zee purlins and is sandwiched between the metal deck and the standing seam metal roof (on large OMA or MCA projects). This system provides a firm surface for the DPW maintenance workers to walk on periodically. If frequent roof access is anticipated, grated walkways may be attached directly to the standing seams with no roof penetrations. This system protects the building insulation from damage and from the effects of gravity/creep that has the tendency to pull exposed insulation down over a period of years.

- Provide roof slopes for maintenance facilities with a roof slope of 2 on 12 rather than the historical 1 on 12. Experience shows that most roofs with a 1 on 12 roof slope ultimately have one or more flat spots created by construction tolerances, steel fabrication errors, and some installation problems.

- Low sloped roofs depend upon caulk to prevent leakage. For a 1 on 12 sloped roof, water will back uphill 12 inches for every 1 inch depth of water. Therefore, any overlap, roof penetration and exposed fastener is immersed in water.

- Provide full length standing seam roof sheets. We have had contractors ship panels up to 55 feet in length by truck to Fort Hood. We have had at least one contractor roll 150 feet long standing seam roof sheets on site. The one piece roof sheets eliminate all end laps, thus reducing the potential roof leaks.

For additional information related to the installation of standing seam metal roofs, contact the DPW. Any paints or adhesives/sealants used in onsite construction at Fort Hood must meet VOC limits presented in Table 8-1 and Table 8-3, respectively.

Exterior Finishes. Exterior finishes should be durable, low maintenance, and preferably locally manufactured (or derived). Recycled content is another consideration. Fort Hood prefers the use of local materials such as brick, concrete, and Texas limestone. Stucco, metal siding (aluminum or steel), and fiber-cement composite materials (e.g. James Hardie™ products) are also good choices. Wood siding, although not preferred due to high maintenance requirements, should be salvaged, locally harvested, or certified.

©Jacobs.

The use of regional building materials should be stressed as these materials are often consistent with regional design aesthetics and are sometimes more responsive to the local climate when compared with materials from other regions.

Any paints or adhesives/sealants used in onsite construction at Fort Hood must meet VOC limits presented in Table 8-1 and Table 8-3, respectively. Factory-applied finishes are required on all exterior metal components.

Metal Siding

When using metal siding:

- Install liner panels on the side walls of maintenance shops to protect the building insulation and to facilitate cleaning.
- Provide hidden fastener sidewall panels if possible.
- Use channel iron side girts for a structural steel buildings that have added sag rods. Connect 1 ½ zee to the channel iron by either welding or using screws. Connect the siding to the zee.

8.13.2.2 Structural Elements

The materials discussed in this section are used in the construction of the building frame and/or foundation. They are generally covered by a finishing product, but can be left exposed. Factory-applied finishes shall be used on all exterior metal. For additional information related to construction methods/requirements for the following materials, contact the DPW.

Concrete. Concrete is among the most common of building materials and is used in some form and to some extent in virtually every construction project. Concrete can provide thermal mass to the building envelope affecting energy performance.

Most concrete mixes contain some percentage of recycled material, generally fly ash or ground granulated blast furnace (GGBF) slag. Fort Hood requires concrete mixes contain at least 15% recycled content. Preference should also be given to locally manufactured material.

Structural Concrete Formwork. Do not detail or specify carton forms for the support of grade beams. This item has failed repeatedly at Fort Hood.

For concrete pavement:

- Provide a joint layout and assure that pavement joints are per the SWD-AEIM. Minimize the use of any dowels or tie bars in the pavement joints.
- Ensure that the contractor sets up perimeter control joints a minimum of every 100 feet for layout of transverse saw joints.
- Ensure that un-reinforced pavement has a length no longer than 1.25 times the width to prevent cracking.

Steel. Steel is another common building material. All steel manufactured in the United States contains recycled content in amounts ranging from 30% (basic oxygen furnace; BOF) to 100% (electric arc furnace; EAF). Typical BOF products include: hollow structural sections, steel studs, steel deck, plate, purlins, and wall studs. Typical EAF products include: beams and columns, channels, angles, plate, steel deck, and piling. Fort Hood requires that any anti-corrosive paints and primers used on steel elements must be no- or low-VOC emitting. All steel (e.g., structural steel, framing/metal studs) used in construction shall be of recycled content.

When using structural steel:

- Detail all moment connections; do not leave this item to the steel fabricator.
- If moment connections are required above the foundation, use bolted rather than welded connections if possible.
- Completely detail the length and size of all welds.
- Indicate the location of all A325 bolts.
- Indicate all framed openings on the structural drawings and framing material size and shape.

For all structural welding, a welding inspector is required to visually inspect and report all job welded joists, beams and moment connections.

Aluminum. All aluminum (e.g., framing/studs) used in construction shall be of recycled material. To produce aluminum from recycled material requires only 5 percent of the energy and greenhouse gas emissions required to produce aluminum from bauxite ore, and each ton of recycled aluminum saves 4 tons of bauxite. In addition, using recycled aluminum instead of raw materials reduces the generation of air pollution, such as SO_X and NO_X, by 95 percent and water pollution by 97 percent.

Photo: Robb Williamson, ©DOE/NREL.

Certified wood has been documented to come from forests managed in accordance with the 10 FSC Principles and Criteria for Forest Stewardship.

Wood Products. Wood is a versatile building material and can be used in structural and non-structural applications. It has the potential to be a truly sustainable resource because it is renewable, biodegradable, non-toxic, energy efficient, and recyclable.

Lumber and wood products used on Fort Hood must be salvaged, certified, or locally harvested. To verify the FSC-certified status of a wood product, Fort Hood requires not only the supplier's Change of Custody certificate, but also an invoice or receipt detailing the FSC-certified status of each product on an individual line-item basis. The use of regional hardwoods such as mesquite, and aromatic cedar should be considered as this stimulates the regional economy and uses a tree considered a nuisance or waste product by many. Ensure wood finishes such as paints, stains, and varnishes are non-toxic.

When using wood studs, Fort Hood prefers the use of finger-jointed studs, which utilizes short pieces of 2x dimensional lumber material glued together to form standard length studs. Using shorter wood sections bonded at the finger joint means using more lumber from each log. Finger joint studs are made for vertical use only and can be used interchangeably with unjointed studs.

Constructing agrifiber panels at Fort Hood.

Alternatives to solid wood products include particle or fiberboard. These products are approved for use on Fort Hood only if they do not contain urea-formaldehyde resins. The use of new agrifiber (e.g., Agriboard™) and composite products made from various materials including sunflower seed hulls, wheat straw, recycled paper, and soy-based resins is also encouraged.

Insulation. Insulation is a critical component of the building envelope. Fort Hood requires an R-value of 19 or greater for walls and R-30 or greater for roofs. In addition to the thermal efficiency of insulation, other attributes of insulating materials to consider are recycled content and toxicity. Fort Hood requires that insulating materials contain at least 20% post-consumer or 40% post-industrial recycled content and are non-toxic. Toxicity is generally associated with the use of formaldehyde or other VOCs to bond fibers, especially in fiberglass batts.

Numerous types of insulating materials are available, including cellulose, cotton, fiberglass, mineral wool, perlite, plastic foams (i.e., polyurethane/polyicynene/ polyisocyanurate), and cementitious foam, containing varying amounts of recycled material up to 100% recycled content. Decisions regarding the type of insulation to use in a specific application must consider cost, environmental characteristics, health concerns, and material performance.

Photo: U.S. Department of Energy. Craig Miller Productions. © DOE/NREL.

Wall Systems. Several new sustainable wall systems have become popular. Two of the most common include insulated concrete forms (ICFs) and structural insulated panels (SIPs). Both of these building techniques eliminate the need for conventional exterior wall framing and reduce the amount of construction waste generated. They are composed of materials that form the interior and exterior walls and an insulating core. The foam insulation used in either system should be expanded polystyrene. Structural wood sheathing and adhesives used in SIPs must be non-toxic. Products that use agricultural by-products (e.g., wheat straw) as the insulating core material should be considered. Concrete used in ICFs should contain recycled content, as discussed above.

Some alternative forms of construction that also have seen resurgence include straw bale and earth construction. Straw bale construction techniques employ the use of agricultural by-products (i.e., baled straw from wheat, oats, barley, rye, rice and other grains). Earth construction includes both earth-sheltered (or earth-covered) design and the use of earth materials to form free-standing walls. Both forms of construction result in structures that are fire resistance, energy efficient, and use locally available building materials.

Fort Hood encourages the use of alternative building methods that are compatible with the regional climate and the end use of the building being constructed.

Vapor Barriers

For Hood requires the architectural design explicitly show maintaining a vapor barrier and insulation barrier around the insulation envelope of the building. Without a well constructed vapor barrier and building pressurization (0.05" wc) an environment for mold growth will occur.

8.14 BUILDING SYSTEMS

Traditionally, building designers analyze the individual components and subsystems of each building and optimize them separately. A sustainable or "whole building" design approach not only evaluates

how materials, systems, and products of a building connect and overlap, but also looks at how the building and its systems can be effectively integrated. The designer must realize that all building systems are interdependent. Mechanical systems design must be coordinated and integrated with the designs of other involved building systems and features including the building envelope, lighting system, and occupant activities. Understanding how one system (or individual components within a given system) affects another is essential to making the most of the available opportunities for energy savings. One of the most effective means of optimizing the energy performance of all building systems is through the use of computer simulation tools. A detailed list of energy simulation software can be found at the U.S. Department of Energy website in the *Building Energy Software Tools Directory* at

http://www.eere.energy.gov.

Building simulation is to be incorporated in the earliest design phases. Building simulation and heat load calculation are required as apart of the design package submission.

Practices such as energy simulation, testing, adjusting, and balancing (TAB) of the HVAC system, and building commissioning (discussed in Section 8.14.1.6 and Section 14.4) must be performed on all building projects as required by American Society of Heating, Refrigerating & Air Conditioning Engineers (ASHRAE) 90.1 and U.S. Army Corps of Engineers (USACE) guide specifications. Fort Hood requires mandatory energy simulation on any building larger than 5,000 square feet.

Simple Energy Analysis Programs:

- **Energy-10**. Intended for performing quick energy simulations.

Detailed Energy Analysis Programs:

- **BLAST.** Performs hourly simulations of buildings, air-handling systems, and central plant equipment. BLAST output may be utilized in conjunction with the LCCID (Life Cycle Cost in Design) program to perform an economic analysis of the building/system/plant design.
- **DOE-2.** Hourly, whole-building energy analysis program calculating energy performance and life-cycle cost of operation. Can be used to analyze energy efficiency of given designs or efficiency of new technologies.
- **VisualDOE.** A Microsoft Windows-based graphical user interface for DOE-2.1. Especially useful for studies of building envelope and HVAC design alternatives.

Special Purpose Programs:

- **HAP.** A versatile system design tool and an energy simulation tool in one package.
- **Trace 700**. HVAC load calculation program that also has many energy analysis capabilities.

8.14.1 Mechanical (HVAC) Systems

HVAC systems supply heating and cooling to the interior spaces of a building, provide fresh air to the occupants, and remove contaminants from the building.

Photo: David Parsons. © DOE/NREL.

HVAC systems are significant contributors to overall building energy consumption, typically contributing 30% to 50% of total building energy usage, as well as affecting the health and comfort of building occupants.

8.14.1.1 HVAC System Design Considerations

An environmentally sound HVAC system is designed to meet occupant needs through the most efficient means at the lowest initial and life-cycle costs. The system must be designed to automatically respond to the local climatic conditions and heat recovery opportunities to provide cost-effective energy conservation measures while assuring set point control. The designer should use strategies that take advantage of the positive climate attributes of the building location, while minimizing the effects of attributes that may impair comfort or increase energy requirements.

System Flexibility. The HVAC design should provide flexibility to address future changes in the building and its functions and use over time. Planning for change includes factoring in potential new user requirements. To the maximum extent possible, system solutions should also accommodate planned future changes and remodeling that may occur.

Cooling and Heating Loads. A building's cooling and heating needs are affected by the performance of interrelated building systems and characteristics, including building envelope characteristics; passive solar design elements, such as daylighting, lighting systems, and other internal loads. The appropriate HVAC design solution should be determined only after the requirements and contributing thermal loads of these interrelated systems have been thoroughly reviewed and all possible efficiency gains through sustainable design strategies have been carefully considered.

To reduce energy consumption, the designer should minimize building internal loads using energy-efficient lighting and office/process equipment (Section 8.14.2; U.S. DOE , FEMP 2000-2004). Typically, the lighting system is one of the largest components of the cooling load, as well as one of the largest contributors to building energy consumption. Daylighting strategies are critically important as a means to reduce artificial lighting needs and the subsequent heat gain from lighting systems. Energy-efficient lighting requirements are outlined in the Fort Hood Energy Office Minimum Performance Specifications (see Sections 8.14.2.2 and 8.14.2.4 for more information on lighting systems. "Envelope" load-reduction measures include adding insulation (see Section 8.13.2.2), awnings or overhangs, window treatments, and landscaping to provide shade and/or wind breaks. For

reducing the latent load, the designer should consider reduction of vapor diffusion through the building envelope using exterior materials and finishes with higher vapor resistance than interior surfaces.

Ventilation. The key design considerations for maintaining adequate indoor air quality (IAQ) include using outdoor air and providing adequate outdoor air ventilation rates. ASHRAE Standard 62-2004 specifies minimum outside air ventilation rates for residential, commercial, institutional, and industrial spaces. These rates for representative buildings at Fort Hood are presented in Table 8-6. The design outdoor air ventilation rate for the breathing zone of the occupied space shall be determined as the sum of ventilation quantities based on people and area outdoor air requirements.

Table 8-6
Minimum Outdoor Air Ventilation Rates in Breathing Zone of Representative Buildings

	Cubic Feet per Minute per Person	Cubic Feet per Minute per Square Foot
Office	5	0.06
Public Assembly	5	0.06
Lodging	5	0.06
Barracks sleeping areas	5	0.06
Retail Sales	7.5	0.12
Food and Beverage Service	7.5	0.18
Lecture classrooms	7.5	0.06
School Classrooms	10	0.12
Health Clubs	20	0.06
Warehouses	-	0.06

Source: ANSI/ASHRAE Standard 62.1-2004

Outdoor air volume of the ventilation system must meet these requirements in all modes of operation. The maximum potential occupancy load should be considered when calculating outside air requirements in all spaces.

Additional requirements to consider for introducing outside air into the building and maintaining adequate IAQ include:

1. Air intake and exhaust locations.
   - Locate outdoor air intakes in areas where the potential for air contamination is lowest.
   - Maximize distance between air intakes and cooling towers, plumbing vents, loading docks, etc. (UFC 3-410-01FA, *Design: Heating, Ventilating, and Air Conditioning*).
   - Maintain a minimum distance of 30 feet between intakes and exhausts (UFC 3-410-01FA).
   - Locate intakes and exhausts on different building faces.
   - Provide ducted return in lieu of door louvers, above ceiling (except in medical facilities) and equipment room plenums.
2. Measures to increase local exhaust ventilation efficiency for industrial buildings. Most industrial buildings (i.e., motor pools, paint booths, etc.) require make-up air to replace the

large volumes of air exhausted to provide acceptable comfort and safety for personnel and acceptable conditions for process operations.

3. Strategies that control ventilation based on actual occupancy. Control ventilation can reduce operating costs by optimizing the rate of outdoor air intake to less than maximum capacity. Demand-controlled ventilation (DCV) describes a control strategy to the actual "demand" for ventilation by regulating the rate at which the HVAC system brings outdoor air into the building. The designer should consider DCV where contaminant levels (i.e., carbon dioxide) result primarily from people and where occupancy varies significantly (gymnasiums, large meeting rooms, and auditoriums). Demand control ventilation should be considered in areas that have varying and high occupancy loads during the occupied periods to vary the amount of outdoor air in response to the need in a zone. DCV is recommended for systems for at least 3,000 cubic feet per minute (cfm) of outdoor air and occupant density greater than 100 people per 1,000 square foot.

Building specific ventilation requirements include:

- Roof centrifugal fans with back draft dampers will be used for warehouse and vehicle maintenance shops.
- All maintenance shops will have systems to remove maintenance pit exhaust.
- Power exhaust systems will be provided for all battery rooms that are interlocked with battery chargers. System will not allow charging unless exhaust system is in operation.

For additional information related to ventilation systems, contact the DPW.

Dehumidification. Except for special applications, the Army prohibits the use of mechanized systems that require additional energy to be used for dehumidification. See Chapters 3 through 6 of AR 11-27, *Army Energy Program*, for more details.

Energy Recovery. Energy recovery is an optional requirement on Fort Hood and shall only be considered in applications where the energy savings payback versus additional design, installation, and maintenance costs are less than 10 years.

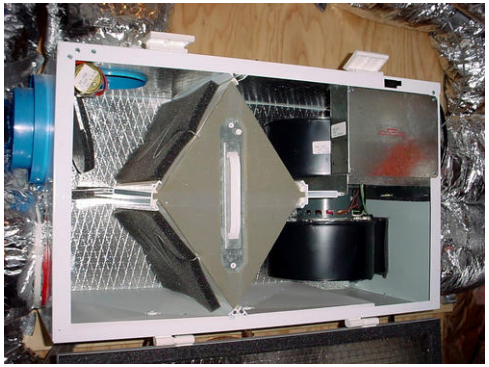


Photo: IBACOS, © DOE/NREL.

Energy recovery ventilation tempers fresh outdoor air before delivery to HVAC equipment.

Photo: Bernard Blessinger, DOE/NREL.

Buildings usually operate under conditions in which the full heating and cooling capacity is not required. Significant improvements in efficiency can result from giving special consideration to part-load conditions.

Specify refrigerants for chillers that are listed on the EPA Strategic New Alternatives Policy (SNAP).

HCFC-22

HCFC-123

HFC-134a

Ammonia

Substitute refrigerants, as authorized under the EPA Significant New Alternatives Policy Program. (U.S. EPA: Lists of Substitutes), for ozone-depleting substances may be considered for use at Fort Hood.

SEER = Seasonal Energy Efficiency Ratio. SEER is the total cooling output (in British thermal units [Btu]) provided by the unit during its normal annual usage period for cooling divided by the total energy input (in watt-hours) during the same period. The higher the SEER number the more energy efficient the equipment.

EER = Energy Efficiency Ratio. EER is the cooling capacity (in Btu per hours) of the unit divided by its electrical input (in watts) at the Air Conditioning and Refrigeration Institute (ARI) standard peak rating condition of 95 degrees Fahrenheit. The higher the EER number the more energy efficient the equipment.

8.14.1.2 HVAC Equipment Sizing Considerations

Determining the correct size of heating and cooling equipment is essential for achieving required temperature and relative humidity in the occupied zone while minimizing initial capital and operating costs. Over-sized equipment cycles on and off more frequently, increasing maintenance costs and failing to remove enough moisture. Correctly sized equipment is especially important in humid climates, such as Fort Hood, where short cycling of air-conditioning equipment can lead to poor humidity control. A **maximum** safety factor of 10% shall be used in heating and cooling load calculations when sizing equipment for use on Fort Hood.

With increased requirements for outside air, the latent loads on space air-conditioning systems often exceed the sensible load. Furthermore, use of energy-efficient lighting and office equipment reduces sensible loads. Since air-conditioning systems are most often controlled by a thermostat responding to sensible heat, it becomes important to provide effective control of interior moisture loads under part-load conditions.

Mechanical systems must be specifically designed to function at full load and part load conditions associated with all projected occupancies and modes of operation. Buildings typically operate at part-load status most of the time; therefore, equipment is required to remain efficient over a wide range of load conditions. Peak system loads occur infrequently and are usually caused by the simultaneous occurrence of multiple factors such as peak occupancy, temperature extremes, and use of occupant equipment. HVAC systems need to respond to various loads in order to achieve the greatest overall efficiency. Staging multiple chillers or boilers to meet part loads is required to improve operating efficiencies and occupant comfort. The designer should consider multiple, modular boilers that are more efficient at partial loads versus a single boiler.

Fort Hood requires the following to reduce energy consumption during part-load conditions:

- **Air System – Part Load Fan Power Limitation**. Individual variable-air-volume (VAV) fans with motors 30 horsepower and larger should have controls and devices that result in fan motor demand of no more than 30% of design power and 50% of design air volume when static pressure set point equals one-third of the total design static pressure. The designer should consider use of variable-speed drives or vane-axial fans in systems of this size.

- **Economizer Cycles.** Shall be included in system design to assist in part load management.

- **Heat Rejection Equipment.** For heat rejection equipment such as cooling towers, the fan must be able to reduce its speed to two-thirds or less if its motor is 7.5 horsepower or larger.

Fort Hood also requires a part-load analysis to be conducted with indoor relative humidity greater than 55% as a failure criterion, in addition to temperature control. This analysis shall be performed with the equipment sized to the normal 97.5% summer criteria, but with the load analysis at moist spring and fall temperate conditions.

8.14.1.3 HVAC Equipment Performance Efficiencies Considerations

Appropriate HVAC equipment should be selected based on which system will satisfy the building's temperature, humidity, and ventilation requirements using the least amount of energy.

Cooling Systems Efficiencies.

Chillers. Chillers are used in large commercial, institutional, and industrial buildings to produce chilled water. This water is pumped to air-handling units to cool the supply air. The chillers use either mechanical refrigeration processes or absorption processes.

Air Conditioners. There are both commercial and residential-grade air conditioning units that consist of an assembly of equipment for the simultaneous control of air temperature, relative humidity, purity, and motion.

Central plants with multiple cooling units are preferred, to permit loss of the largest unit while maintaining at least 65% design capacity. Where the master plan calls for multiple buildings in an area, in the design provide for future expansion of the central plant. Chilled water

Table 8-7
Air-cooled Electric Chiller Efficiency for Commercial HVAC Equipment

Compressor Type and Capacity	Part Load Optimized Chillers	Full Load Optimized Chillers
	IPLV (kW/ton)	Full Load (kW/ton)
Scroll (30-60 ton)	≤0.86	≤1.23
Scroll (30-60 ton)	≤0.86	≤1.23
Reciprocating (30-150 ton)	≤0.90	≤1.23
Screw (70-200 ton)	≤0.98	≤1.23

Key:
IPLV = Integrated Part-Load Value. IPLV is a weighted average of efficiency measurements at various part-load conditions, as described in ARI Standard 550/590-98.

Source: Federal Energy Management Program (FEMP) 2003.

Table 8-8
Water-cooled Electric Chiller Efficiency for Commercial HVAC Equipment

Compressor Type and Capacity	Part Load Optimized Chillers	Full Load Optimized Chillers
	IPLV (kW/ton)	Full Load (kW/ton)
Centrifugal (150-299 ton)	≤0.52	≤0.59
Centrifugal (300-2000 ton)	≤0.45	≤0.56
Rotary Screw (> 150 ton)	≤0.49	≤0.64

Source: FEMP 2004.

Table 8-9 Unitary Air Conditioner Efficiency for Commercial HVAC Equipment	
Product Type and Size	
< 65 MBtu/hr	≥12.0 SEER
65 –135 Mbtu/hr	≥11.0 EER ≥11.4 IPLV
> 135 –240 MBtu/hr	≥10.8 EER ≥11.2 IPLV

Source: FEMP 2004.

Table 8-10 Residential Air Conditioner Efficiency	
Product Type and Size	
Split Systems	≥11.0 EER ≥13.0 SEER
Single Package	≥10.5 EER ≥12.0 SEER

Source: FEMP 2002.

is preferred over air cooled systems. When refrigerant must be contained inside a building, comply with ASHRAE 15.

Efficiency requirements for individual cooling equipment are provided in Tables 8-7 through 8-10. Equipment must meet or exceed the seasonal energy efficiency ratio (SEER) or energy efficiency ratio (EER) for the required capacity. The cooling equipment should also meet or exceed the integrated part-load value (IPLV) where applicable.

For central refrigeration air-conditioning systems:

1. Show freeze protection for all exposed piping and components for outdoor packaged chiller units.

2. The preferred water chiller unit is the outdoor packaged unit with the air cooled refrigerant condenser rather than the water cooled condensers; chilled water rather than DX. If 150 tons or more the preference is go to water cooled type.

3. Provide alarm/detection/exhaust/ventilation of refrigerant in mechanical rooms and confined spaces IAW ASHRAE 15.

4. Single Zone air handling units must have a preheat and a reheat coil. Provide supply air to the facility that will not create a high humidity condition during any season. Variable temperature chilled water single zone units are not acceptable without a reheat coil to prevent high humidity in spaces.

   Variable temperature, constant air flow systems shall be provided only with humidity control. Variable volume, constant temperature systems are preferred due to the cold deck's ability to drop moisture from the air stream.

   For additional information related to refrigeration air and condition system construction requirements, contact the DPW.

   Heating Systems Efficiencies.

   Boilers. Boilers are typically used to generate hot water or steam for space heating, domestic water heating, and industrial processes. Boilers are available in condensing and non-

condensing models. At a minimum, the recommended thermal efficiency for boilers used at Fort Hood is 90% E_t.

If using hot water generators/boilers for heat, Fort Hood requires the use multiple units in central plants and gas-fired units for domestic water heaters. Fort Hood also requires the use of onboard steam generators on equipment requiring steam or a small steam boiler just for the year-round steam load. Lo-NO_X hot water heaters and boilers shall be provided in accordance with Texas Commission on Environmental Quality, Chapter117, Subchapter D, paragraph 117.460.

Solar-assisted systems (see Section 8.14.5.2) should be considered as alternatives to conventional boiler systems. Additionally, opportunities for cogeneration should be considered (see Section 8.14.6). No boiler size should be equal to or greater than 10 million Btu.

Furnaces. High-efficiency gas-fired furnaces should be considered for residential and small commercial heating systems. Natural gas furnaces are available in condensing and non-condensing models. Fort Hood requires that furnaces be at least 90% efficient.

Ground-source Heat Pumps. Fort Hood is committed to the use of ground-source heat pumps (GSHPs), also known as geothermal heat pumps. GSHPs replace the need for a boiler by using the ground as a heat source during winter operation. In summer, the heat from a building is rejected to the ground. GSHPs are classified according to the type of heat exchanger loop field used. The most common are closed-loop horizontal and closed-loop vertical systems. GSHP units have life spans of 20 years or more. GSHPs for use at Fort Hood are required to comply with the efficiency standards set forth in Table 8-11. Note: A comparison of IFS maintenance cost of Buildings 194 and 4612 (using the heat pump) versus the electrical energy cost of Buildings 5674 and 4612 (using 40% of 5674) supports the use of geothermal heat pumps at Fort Hood. A detailed analysis is always necessary to be accurate beyond the comparison stated.

Warm Air Heating Systems. Always use vented make-up air systems for Maintenance Shops rather than direct fired systems. Flues for gas fired systems shall be installed in accordance with current NFPA standards. For additional information related to air heating system construction requirements, contact the DPW.

Table 8-11
Ground-source Heat Pump Efficiency

Product Type	EER	COP
Closed Loop	>14.1	>3.3
Open Loop	>16.2	>3.6

Key:

COP = Coefficient of Performance. COP is the heating capacity (Btu/hr) of the unit divided its electrical input (Btu/hr) at standard (ARI/OSO 13256-1) conditions.

Source: FEMP 2001.

Radiant Heating Systems. Radiant systems that rely on radiation heat transfer are generally more energy efficient than air-based systems. Applications of this technology at Fort Hood include infrared radiant heating for high bay areas or where spot heating is required.

8.14.1.4 General Equipment Considerations for HVAC Systems

HVAC Motor Considerations. The designer shall specify high-efficiency motors for HVAC systems. Motor efficiencies for representative minimum sizes are presented in Table 8-12.

Table 8-12
Motor Efficiency

Motor Size (hp)	1200 rpm	1800 rpm	3600 rpm
1	82.5	85.5	77.0
3	88.5	89.5	85.5
5	89.5	89.5	86.5
10	91.7	91.7	89.5
20	92.4	93.0	91.0
30	93.6	94.1	91.7
40	94.1	94.1	92.4
50	94.1	94.5	93.0

Key:
hp = horsepower.
rmp = revolutions per minute.
Source: FEMP 2001.

HVAC Air Distribution Considerations. Zone Air Distribution Effectiveness (Ez) is a measure of how effectively the zone air distribution system uses its supply air to maintain acceptable air quality in the breathing zone. Most buildings at Fort Hood are mechanically ventilated; therefore, the designer shall design ventilation systems that result in an air change effectiveness greater or equal to 0.9. To increase ventilation effectiveness, the designer should pay close attention to locations of supply air introduction into the building and return air outlet locations. For cooling mode, return air shall exhaust from a location that takes advantage of any thermal stratification design. Cooling air should be introduced as close to the heat sources as possible. For heating mode, thermal stratification is discouraged. Warm air is to be introduced at points low in the large space.

Conventional ventilation design that locates supply and return air vents in the ceiling is not preferred for use at Fort Hood because it has low ventilation effectiveness and may trigger short-circuiting of airflow delivery. The air delivery technologies of displacement ventilation and under-floor air delivery are preferred for use by Fort Hood:

- **Displacement Ventilation**. In displacement ventilation, conditioned air with a temperature slightly lower than the desired room air temperature in the occupied zone is supplied from air outlets at low velocities (100 feet per minute [fpm] or less). The outlets are located at or near the floor level and the supply air is introduced directly to the occupied zone.

8.14.1.5 HVAC Testing, Adjusting, and Balancing

Testing, adjusting, and balancing (TAB) is the process of checking and regulating all mechanical systems in a building to produce the design objectives shall be conducted in accordance with *UFGS-15990A Testing, Adjusting, and Balancing of HVAC Systems*. TAB procedures include:

- Balancing air and water distribution systems;

- Adjusting systems to provide design quantities;
- Establishing quantitative performance of all equipment; and
- Verifying automatic control system operation and sequences of operation.

Systems will be inspected for conformity to design. Measuring and establishing the air and fluid quantities, as required to meet design specifications, recording, and reporting the results will be required in accordance with UFGS-15995A, *Commissioning of HVAC Systems*.

All TAB work shall be performed under the direct guidance of the TAB specialist. The TAB specialist shall participate in the commissioning process specified in UFGS-1599A.

The TAB Specialist shall provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation. The TAB Specialist shall ensure that the location and details of ports, terminals, connections, etc., necessary to perform TAB are identified on the submittals.

TAB procedures will be conducted on all mechanical systems greater than 5 tons by a certified TAB firm. A schematic drawing showing each system component, including balancing devices, shall be provided for each system. Each drawing should be accompanied by a copy of all report forms required.

The TAB report will include three copies of the appropriate schematic drawings and TAB-related submittals along with the completed report forms for each system. Any deficiencies outside of the realm of normal adjustments and balancing during TAB execution shall be noted along with a description of corrective action performed to bring the measurement into the specified range.

Building commissioning is a practice to ensure building systems are installed, operate, and are maintained to meet design goals. **Testing, adjusting, and balancing (TAB)** is an essential element of the commissioning process that ensures all components of HVAC operate according to the design intent.

8.14.1.6 Commissioning of HVAC Systems

The work described in this section shall begin only after all work required in related sections, including UFGS-15951, *Direct Digital Control for HVAC and Other Local Building Systems*, and UFGS-15990A, *Testing, Adjusting and Balancing of HVAC Systems*, has been successfully completed, and all test and inspection reports and operation and maintenance manuals required in these specifications have been submitted and approved.

Photo: Robb Williamson, © DOE/NREL.

An energy management control system can be used to avoid unnecessary peak demand charges by employing peak shaving and demand limiting functions.

Photo: Davis Energy Group – David Springer, © DOE/NREL.

Coordinating temperature settings with building occupancy periods helps minimize unnecessary building heating and cooling.

The contractor shall designate team members to participate in the pre-commissioning checks and the functional performance testing. Pre-commissioning checks shall be performed for the items indicated on the checklists in Appendix A of UFGS-15995A.

Functional performance tests shall be performed for the items indicated on the checklists in Appendix B of UFGS-15995A. Functional performance tests shall begin only after all pre-commissioning checks have been successfully completed. Tests shall prove all modes of the sequences of operation. Tests shall begin with equipment or components and shall progress through subsystems to complete systems.

Fort Hood requires commissioning on all mechanical systems over 10 tons.

8.14.1.7 HVAC Controls

Direct digital control (DDC) systems shall be used with a graphic, operator interface panel whenever a chilled water system or heating water system is used. When unitary types of HVAC equipment are used and a programmable thermostat is the commercial norm; provide the thermostat with onboard electronic control sequences of the unitary equipment.

- USACE Army Standard Control sequences shall be used, adapted into the DDC system.
- CAD drawing files and technical manual are at http://en.sas.usace.army.mil/hvac/tcd.htm.
- DDC control systems shall be LONWORKS compatible.
- Specifications 15950 and 15951: CEGS Specifications in SGML Format.

8.14.1.8 Building Controls

Fort Hood has initiated a Utility Monitoring and Control System (UMCS) that serves as the foundation for a base-wide system for monitoring and managing facilities. A UMCS reduces energy use in the buildings by monitoring conditions and controlling energy-consuming equipment through an integrated network of sensors, controllers, actuators, and software. The UMCS allows a facility manager to perform diagnostics and optimize system performance by employing the following system capabilities:

- *Start/stop controls* limit operating hours of equipment according to predetermined schedules;
- *Optimum start/stop controls* delay bringing equipment online until the latest possible time;
- *Temperature setback/setup* saves energy by allowing building conditions to drift (within predefined limits) during unoccupied periods;
- *Enthalpy control* provides more sophisticated economizer control that is based on both temperature and humidity;
- *Supply temperature reset modulates* circulating water temperature based on load sensors and program logic;
- Duty cycling reduces utility peak demand charges by turning off equipment for a predetermined percentage of time;
- Demand limiters shed nonessential equipment, to reduce peak power demand to a preset level. Facilities with low-load factors or steep load-duration curves are best candidates for cost-effective peak shedding;
- Monitoring provides capabilities to track equipment run-time and other parameters for proactive maintenance, and energy consumption for cost containment; and
- Load management controls stage the start-up of large energy-consuming equipment to avoid power peaks.

Functional Area: Building space used for a specific function, such as office space, cafeterias, living spaces, maintenance shops, and classrooms.

In addition to regulating HVAC systems, such control systems can be inter-tied with lighting, electric power (such as load shedding), elevators, service hot water, access control and security, telecommunications, and information management.

Individual buildings at Fort Hood, either newly constructed or undergoing renovation, are required to be equipped with direct digital control (DDC) systems that are compatible with Fort Hood's UMCS. Small buildings and residential housing units should be equipped with programmable thermostats.

The following building control strategies shall be used to further reduce energy usage:

- Set up HVAC system to operate according to need. Time-of-day scheduling is useful when it is known which portions of the building will have reduced occupancy.
- Select the room or space that best represents the thermal characteristics of the space based on both external and internal loads. This will provide the greatest comfort level to occupants.
- Locate a temperature sensor for a zone in a room representative of that entire zone. The number of spaces in a zone and the location of the temperature-sensing point will affect the control of temperature in the various spaces of a zone.

As noted in ***Greening Federal Facilities*** (2001), some of the highest efficiency luminaries, or lighting devices, have inferior photometric performance. The most effective luminaries are usually not the most energy efficient by themselves, but they deliver light where it is needed. As such, they eliminate the use of excess luminaries. Thus, lighting must be reviewed as an overall system in an area.

Illumination: The amount of light, measured in foot-candles or in lumens, at a work surface.

8.14.2 Interior Lighting and Lighting Controls

Interior lighting systems account for 25% or more of the overall energy requirements of a typical federal building. Reducing costs and improving the overall quality of life at Fort Hood are priorities of the installation. It is important to design interior lighting systems that provide illumination levels that match, but do not exceed, the needs of a building's functional areas, based on the tasks typically performed in those areas.

The use of natural light, called daylighting, helps reduce the electrical energy load from illumination and reduces a building's cooling load. Determining the extent daylighting is to be incorporated into the building's design is the first step in designing the overall lighting system for the building. Daylighting is discussed in more detail in Section 8.14.5.1.

Proper lighting system design provides a comfortable illumination level in an interior environment while minimizing energy use. Lighting systems are building-specific and require design by a Certified Lighting Designer who understands the users' needs and is familiar with balancing daylighting, artificial lighting, illumination needs, to develop an ideal lighting plan for a high-performance building.

The sustainable aspects of the lighting equipment discussed in this section focus on energy consumption and solid waste generation.

8.14.2.1 Illumination Levels

Determining the illumination levels of a light system is about meeting the needs of each functional area based on the area's use and quality of lighting needed (direct, indirect, combination). The following are the illumination standards set forth by Fort Hood.

Ambient lighting is typically used for general lighting in both office and common space. The ambient lighting load for activities at Fort Hood shall be in accordance with Table 8-13. The methodology for calculating lighting power densities for common space types and specific space types is found at the end of Table 8-13 (ASHRAE Standard 90.1-2001). Deviations from this requirement should be submitted in writing and approved during the design charrette process.

Task lighting provides additional illumination to specific areas. As such, task lighting should be limited to areas where tasks requiring higher illumination levels are performed, such as desk top working spaces.

Accent lighting is directional lighting to emphasize a particular object or draw attention to part of a particular space. The use of accent lighting should be minimized. If used, select the lowest-level illumination feasible for all necessary accent lighting, and control such lighting using occupancy sensor switches.

Photo: E&R Int., LTD. ©DOE/NREL.

The variety of commercially-available fluorescent lighting shapes and sizes is vast, and continues to expand.

EnergyStar-approved lighting should be used in all cases where such lighting is available and meets the needs of the specified use. Replacing a 100-watt incandescent with a more efficient 32-watt cathode fluorescent lamp (CFL) can save a user at least $30 in energy costs over the life of the bulb.

Excessive illumination wastes energy and provides an uncomfortable level of brightness to room occupants.

Table 8-13
Lighting Power Densities Using the Space-by-Space Method

Building Type	Space-by-Space Method Light Power Densities (LPDs)																	
	Common Space Types and LPDs (W/ft²)																	Building Specific Space types and LPDs (W/ft²)
	Office-Enclosed	Office-Open Plan	Conference Meeting/ Mutipupose	Classroom/Lecture/ Training	Audience/ Seating Area	Lobby	Atrium-first three floors	Atrium-each additional floor	Lounge/Recreation	Dialing Area	Food Preparation	Restrooms	Corridor/ Transition	Stairs/Archive	Active Storage	Inactive Storage	Electrical/ Mechanical	
Athletic Facility Buildings																		
Gymnasium	1.5	1.3	1.5		0.5	1.8	1.3	0.2	1.4	1.4	2.2	1.0	0.7	0.9	1.1	0.3	1.3	Playing Area 1.9 Dressing/Locker/Fitting Room 0.8 Exercise Area 1.1
Exercise Center	1.5	1.3	1.5		0.5	1.8	1.3	0.2	1.4	1.4	2.2	1.0	0.7	0.9	1.1	0.3	1.3	Exercise Area 1.1 Dressing /Locker/Fitting Room 0.8
Civil Services Buildings																		
Courthouse	1.5	1.3	1.5	1.6	1.6	1.8	1.3	0.2	1.4	1.4	2.2	1.0	0.7	0.9	1.4	0.3	1.3	Courtroom 2.1 Confinement Cells 1.1 Judges Chambers 1.1
Police Stations	1.5	1.3	1.5	1.6	1.6	1.8	1.3	0.2	1.4	1.4	2.2	1.0	0.7	0.9	1.4	0.3	1.3	Police Station Laboratory 1.8
Fire Stations	1.5	1.3	1.5	1.6		1.8			1.4	1.4	2.2	1.0	0.7	0.9	1.4	0.3	1.3	Fire Station Engine Room 0.9 Sleeping Quarters 1.1
Post Office	1.5	1.3	1.5	1.6		1.8	1.3	0.2	1.4	1.4	2.2	1.0	0.7	0.9	1.4	0.3	1.3	Sorting Area 1.7
Town Hall	1.5	1.3	1.5	1.6	1.6	1.8				1.4	2.2	1.0	0.7	0.9	1.4	0.3	1.3	
Convention Center Building																		
Convention Center	1.5	1.3	1.5	1.6	0.5	1.8	1.3	0.2	1.4	1.4	2.2	1.0	0.7	0.9	1.4	0.3	1.3	Exhibit Space 3.3

Table 8-13
Lighting Power Densities Using the Space-by-Space Method

Building Type	Space-by-Space Method Light Power Densities (LPDs)																	
	Common Space Types and LPDs (W/ft^2)																	Building Specific Space types and LPDs (W/ft^2)
	Office-Enclosed	Office-Open Plan	Conference Meeting/ Mutipupose	Classroom/Lecture/ Training	Audience/ Seating Area	Lobby	Atrium-first three floors	Atrium-each additional floor	Lounge/Recreation	Dialing Area	Food Preparation	Restrooms	Corridor/ Transition	Stairs/Archive	Active Storage	Inactive Storage	Electrical/ Mechanical	
Educational Buildings																		
School /University	1.5	1.3	1.5	1.6		1.8	1.3	0.2	1.4	1.4	2.2	1.0	0.7	0.9	1.4	0.3	1.3	
Library	1.5	1.3	1.5	1.6		1.8	1.3	0.2		1.4	2.2	1.0	0.7	0.9	1.4	0.3	1.3	Card File and Cataloging 1.4
																		Stacks 1.9
																		Reading Area 1.8
Food Service Buildings																		
Dining Bar Lounge/Leisure	1.5	1.3	1.5			1.8	1.3	0.2	1.4	1.2	2.2	1.0	0.7	0.9	1.4	0.3	1.3	
Dining: Family	1.5	1.3	1.5			1.8	1.3	0.2	1.4	2.2	2.2	1.0	0.7	0.9	1.4	0.3	1.3	
Dining: Cafeteria	1.5	1.3	1.5			1.8	1.3	0.2	1.4	1.4	2.2	1.0	0.7	0.9	1.4	0.3	1.3	
Hospital/Healthcare Buildings																		
Hospital/Healthcare	1.5	1.3	1.5			1.8	1.3	0.2	1.4	1.4	2.2	1.0	0.6	0.9	2.9	0.3	1.3	Emergency 2.8
																		Recovery 2.6
																		Nurse Station 1.8
																		Exam/Treatment 1.6
																		Pharmacy 2.3
																		Patient Room 1.2
																		Operating Room 7.6
																		Nursery 1.0
																		Medical Supply 3.0
																		Physical Therapy 1.9
																		Radiology 0.4
																		Laundry-Washing 0.7

Table 8-13
Lighting Power Densities Using the Space-by-Space Method

Building Type	Space-by-Space Method Light Power Densities (LPDs)																	
	Common Space Types and LPDs (W/ft²)																	Building Specific Space types and LPDs (W/ft²)
	Office-Enclosed	Office-Open Plan	Conference Meeting/ Mutipupose	Classroom/Lecture/ Training	Audience/ Seating Area	Lobby	Atrium-first three floors	Atrium-each additional floor	Lounge/Recreation	Dialing Area	Food Preparation	Restrooms	Corridor/ Transition	Stairs/Archive	Active Storage	Inactive Storage	Electrical/ Mechanical	
Industrial Buildings																		
Workshop	1.5	1.3	1.5			1.8	1.3	0.2	1.4	1.4	2.2	1.0	0.7	0.9	1.1	0.3	1.3	Workshop 2.5
Automotive Facility	1.5	1.3	1.5			1.8	1.3	0.2	1.4	1.4	2.2	1.0	0.7	0.9	1.1	0.3	1.3	Garage Service/Repair 1.4
Manufacturing	1.5	1.3	1.5			1.8	1.3	0.2	1.4	1.4	2.2	1.0	0.5	0.9	1.1	0.3	1.3	General Low Bay (<25 ft Floor to Ceiling Height) 2.1 General High Bay (>25 ft Floor to Ceiling Height) 3.0 Detailed 6.2 Equipment Room 0.8 Control Room 0.5
Lodging Building																		
Hotel	1.5	1.3	1.5	1.6		1.7	1.3	0.2	1.4	1.0	2.2	1.0	0.7	0.9	1.1	0.3	1.3	Guest Rooms 2.5
Motel	1.5	1.3	1.5	1.6		1.8	1.3	0.2	1.4	1.2	2.2	1.0	0.5	0.9	1.1	0.3	1.3	Guest Rooms 2.5
Multi-Family	1.5	1.3	1.5			1.8	1.3	0.2	1.4	1.4	2.2	1.0	0.5	0.9	1.1	0.3	1.3	Private Living Space
Dormitory	1.5	1.3	1.5			1.8	1.3	0.2	1.4	1.4	2.2	1.0	0.5	0.9	1.1	0.3	1.3	Living Quarters 1.9
Museum Buildings																		
Museum	1.5	1.3	1.5	1.6		1.8	1.3	0.2				1.0	0.7	0.9	1.4	1.4	1.3	General Exhibition 1.6 Restoration 2.5
Office Buildings																		
Office	1.5	1.3	1.5	1.6		1.8	1.3	0.2	1.4	1.4	2.2	1.0	0.7	0.9	1.1	0.3	1.3	Banking Activity Area 2.4

Table 8-13
Lighting Power Densities Using the Space-by-Space Method

Building Type	Space-by-Space Method Light Power Densities (LPDs)																		
	Common Space Types and LPDs (W/ft²)																	Building Specific Space types and LPDs (W/ft²)	
	Office-Enclosed	Office-Open Plan	Conference Meeting/ Mutipupose	Classroom/Lecture/ Training	Audience/ Seating Area	Lobby	Atrium-first three floors	Atrium-each additional floor	Lounge/Recreation	Dialing Area	Food Preparation	Restrooms	Corridor/ Transition	Stairs/Archive	Active Storage	Inactive Storage	Electrical/ Mechanical		
Penitentiary Buildings																			
Penitentiary	1.5	1.3		1.4	1.9	1.8			1.4	1.4	2.2	1.0	0.7	0.9	1.1	0.3	1.3	Confinement Cells	1.1
Religious Buildings																			
Religious Building	1.5	1.3	1.5	1.6	3.2	1.8	1.3	0.2	1.4		2.2	1.0	0.7	0.9	1.1	0.3	1.3	Worship-Pulpit/Choir	5.2
																		Fellowship Hall	2.3
Retail Buildings																			
Retail	1.5	1.3	1.5			1.8	1.3	0.2	1.4	1.4	2.2	1.0	0.7	0.9	1.1	0.3	1.3	General Sales Area For accent lighting, see 9.3.1.2(c)	2.1
																		Mail Concourse	1.8
Sports Arena Building																			
Sports Arena	1.5	1.3	1.5		0.5	1.8	1.3	0.2	1.4	1.4	2.2	1.0	0.7	0.9	1.1	0.3	1.3	Ring Sports Area	3.8
																		Court Sports Arena	4.3
																		Indoor Playing Field Area	1.9
Storage Buildings																			
Warehouse	1.5	1.3	1.5			1.8	1.3	0.2				1.0	0.7	0.9	1.1	0.3	1.3	Fine Material Storage	1.6
																		Medium/Bulky Material Storage	1.1
Parking Garage	1.5					1.8						1.0	0.7	0.9	1.1	0.3	1.3	Parking Area-Pedestrian	0.2
																		Parking Area-Attendant Only	0.1
Theater Buildings																			
Performing Arts	1.5				1.8	1.2	1.3	0.2	1.4			1.0	0.7	0.9	1.1	0.3	1.3		
Motion Picture					1.3	0.8			1.4			1.0	0.7	0.9	1.1	0.3	1.3		

Table 8-13
Lighting Power Densities Using the Space-by-Space Method

Building Type	Space-by-Space Method Light Power Densities (LPDs)																		
	Common Space Types and LPDs (W/ft^2)																	Building Specific Space types and LPDs (W/ft^2)	
	Office-Enclosed	Office-Open Plan	Conference Meeting/ Mutipupose	Classroom/Lecture/ Training	Audience/ Seating Area	Lobby	Atrium-first three floors	Atrium-each additional floor	Lounge/Recreation	Dialing Area	Food Preparation	Restrooms	Corridor/ Transition	Stairs/Archive	Active Storage	Inactive Storage	Electrical/ Mechanical		
Transportations Buildings																			
Transportation	1.5	1.3	1.5		1.0	1.8	1.3	0.2	1.4	1.4	2.2	1.0	0.7	0.9	1.1	0.3	1.3	Airport-Concourse	0.7
																		Air/Train/Bus-Baggage Area	1.3
																		Terminal-Ticket counter	1.8

Source: ASHRAE Standard *90.1-2001 (Table 9.3.1.2*).

Space-by-Space Method of Calculating Interior Light Power Allowance. Use the following steps to determine the interior lighting power allowance by the space-by-space method:

a. Determine the appropriate building type. For building types not listed, selection of a reasonably equivalent typed shall be permitted.

b. For each space enclosed by partitions 80% or greater than ceiling height, determine the gross interior floor area by measuring o the center of the partition wall. Include the floor area of balconies or other projections. Retail spaces do not have to comply with the 80% partition height requirements.

c. Determine the interior lighting power allowance by using the columns designated space-by-space method. Multiply the floor area(s) of the spaces(s) times the allowed lighting power density for the space type that most closely represents the proposed use of the space(s). For space types not listed, selection of a reasonable equivalent category shall be permitted.

d. The interior lighting power allowance is the sum of lighting power allowances of all the spaces. Trade-offs among spaces are permitted provided that the total installed interior lighting power does not exceed the interior lighting power allowance.

8.14.2.2 Luminary and Light Source Selection

Fluorescent lighting is some of the most energy efficient artificial lighting available and is the best type of light for most applications at Fort Hood. In addition, it works well in conjunction with daylighting. Fort Hood requires lighting designs to maximize fluorescent lighting use, to include the use of linear, U-bent fluorescent lighting, and compact fluorescent lamps. Fort Hood's specific requirements are:

- T8 or T5 lamps;
- Minimum color rendering index of 75;
- Color temperature of 3,500 degrees Kelvin;
- Minimum life of 15,000 hours; and;
- Minimum design lumens of 25,000.

Fort Hood also requires all fluorescent lighting ballast be only electronic ballasts (see Section 8.14.2.3). T8 lamps (tubular fluorescent lamps, 1-inch in diameter) should be used for the retrofitting of existing fixtures. T5 lamps should be considered for new construction. T12 lamps or magnetic ballasts are **not** considered suitable for use at Fort Hood.

Light-emitting diode (LED) lighting systems offer extremely energy-efficient alternatives to some incandescent lighting system components. The diversity of LED lighting applications is rapidly increasing as this technology evolves and demand for it grows. LED lighting should be considered for various parts of a building's lighting system, such as in spotlighted areas at building entranceways.

Fort Hood discourages the use of incandescent lamps, halogen lamps, and mercury vapor lamps. Incandescent spotlights should also be avoided, with more energy-efficient alternatives used instead.

8.14.2.3 Ballast Selection

Ballasts play a large role in energy efficiency of an entire lighting fixture. Electronic ballasts are required, not only for their higher energy efficiency in comparison to magnetic ballasts, but also because they minimize flicker and do not hum. There are two common types of ballasts: instant-start and rapid-start. Instant-start ballasts are slightly more energy efficient than rapid-start ballasts, but

Use of light-emitting diode, or LED lighting, as well as fluorescent lighting, requires significantly less power than is required by incandescent lighting. Lamp life of linear fluorescent lamps and CFLs is up to seven times that of incandescent bulbs; thus, less solid waste is generated by the use of fluorescent bulbs.

Photo: Chris Gunn Photography, ©DOE/NREL.

Use of CFLs in lighting systems that are operated nearly every day of the year significantly reduces energy consumption.

they can reduce lamp life by up to 25%. Thus, there is an increased solid waste volume generated from using them, as well as an increased maintenance cost. Rapid-start ballasts are required for use with dimming switches. Rapid-start units shall be considered first in all fluorescent lighting system applications.

Use of occupancy sensors in combination with photocell sensors helps prevent unnecessary illumination of areas seldom occupied and offer sufficiently illuminated by natural light.

Other considerations when choosing appropriate ballasts are the power factor, ballast factor, and total harmonic distortion. In accordance with Greening of Federal Facilities (May 2001) recommendation, Fort Hood requires the following ballast selections:

- Ballast power factors (PF) of 0.95 or higher to help reduce current loads on building wiring and transformers;
- Use a ballast factor (BF) of 0.85 to 1.0 to maximize the light output from a lamp/ballast combination without over-taxing the lamps, which will shorten lamp life; and
- Total harmonic distortion (THD) of 20% or less, or 5% or less in areas containing sensitive electronic equipment.

In addition to PF, BF, and THD, select ballasts that can operate with in the temperature range of the functional area in which they are to be used. Typical ballast minimum starting temperature is 50 degrees Fahrenheit (°F), although low-temperature starting ballasts (10°F) are available. Unheated areas where temperatures will be lower than 10°F are not suitable for conventional fluorescent lighting.

8.14.2.4 Lighting Controls

Additional energy conservation can be achieved by simply not operating lighting when it is not needed. Select lighting controls to ensure lighting operation that will effectively meet a functional area's illumination requirements. Lighting control selection must be done in coordination with the functional area use, as well as the overall building setting. Control selection must also be coordinated with ballast selection when applied to luminaries requiring ballasts.

Area Control. Each area enclosed by ceiling-height partitions shall have an independent switching or control device (manually operated or automatically controlled by an occupant-sensor). This switching or control device shall be (1) readily accessible; and (2) located so that a person using the device can

see the lights or area controlled by that switch, or so that the area being lit is annunciated. Other devices may be installed in conjunction with the switching or control device provided they permit the switching or control device to override the action of all other devices in each area enclosed by the ceiling–height partition and they rest the mode of any automatic system to normal operating without further action. Exceptions would be for any area within a building that must be continuously illuminated for reasons of building security and emergency egress.

Manual Controls. Manual controls can provide energy conservation if they are properly used, but they require occupant effort input, which is not always consistent. For conventional switching in rooms equipped with multiple ceiling fixtures, configure switching to permit use of only one-third or one-half of the lighting within each fixture. Also, if small portions of a room are used for functions requiring much higher illumination levels than the remainder of the room, provide additional lighting fixtures (such as task lights) that can be used independently of the other room lights.

Automatic Lighting. Automatic lighting controls help achieve energy conservation without occupant input. Automatic controls approved for use at Fort Hood include the following:

- *Occupancy sensor switches (OSSs)*, which use passive infra-red (PIR) switches that detect the presence of a person in a space, are required by the Fort Hood Energy Office for all administration and command and control facilities. OSSs are also specified in areas used for administration, classroom, and enclosed office space of non-administrative buildings. OSSs requirements:
  - The device shall have an attractive, low-profile, and unobtrusive appearance.
  - When a room is occupied, the device shall give the occupant control over the lights.
  - Users shall be able to turn off the lights even when the room is occupied.
  - Sensors should be placed at least 4 feet from windows and HVAC ducts to avoid false readings from moving air in a room.
  - OSS mounting, as follows:

Photo: Lawrence Berkeley National Laboratory. ©DOE/NREL.

Photosensing switches can effectively control room lighting as well as curtain control.

Fort Hood's Lighting Control Requirement

The Fort Hood Energy Office currently requires occupancy sensor switches (OSSs) to be specified for all administration and command & control facilities on Post. OSSs are also specified in areas used for administration, classroom, and enclosed office space of non-administrative buildings.

Table 8-14 Energy Savings When Combining Controls		
Basic Strategy	**Combined with**	**Percent Energy Reduction (average)**
Motion sensing	Daylighting	40% - 45% savings
Motion sensing	Daylighting and dimming or tuning	45% - 50%
Daylighting	Dimming and tuning	30% - 35%
Daylighting	Dimming or tuning and scheduling	35% - 40%

Note: Energy-saving yields are in comparison to manual switching.

Source: UFC 3-520-01, *Interior Electrical Systems*.

- *Individual office space.* Wall- or ceiling-mounted PIR OSSs, 120-degree coverage angle minimum for wall mount, and 360-degree coverage area for ceiling mount;
- *Multiple-use office space (unobstructed).* Ceiling-mounted PIR, 360-degree coverage area;
- *Multiple-user office space (cubicles).* Ceiling-mount, dual-technology PIR and ultrasonic OSS; 360-degree coverage area;
- *Conference rooms.* Ceiling-mounted PIR, 360-degree coverage; and
- *Large storage rooms.* Ceiling-mount, dual-technology PIR and ultrasonic OSS; 360-degree coverage area.

Fort Hood encourages designers to consider the applicability of OSSs for all rooms that are intermittently occupied over the course of the day, that do not have natural light sources, or that are not used as sleeping quarters.

- *Motion sensor* switches turn lighting on when motion is detected in an area.
- *Photocell switches* turn lights off when sufficient natural light is entering an area. Photocell switches should be used in conjunction with areas designed for daylighting. These can be stand-alone units or used in combination with OSSs. Interior photosensors shall not have a mechanical slide cover or other device that permits easy unauthorized disabling of the control, and shall not be incorporated into a wall-mounted occupant-sensor.
- *Automatic Time Switch Control Devices* turn lights off and on based on preset times. Automatic time switch control devices shall: (1) be capable of programming different schedules for weekdays and weekends; and (2) have program backup capabilities that prevent the loss of the device's program and time setting for at least 10 hours if power is interrupted.

Scheduling and Tuning of Automatic Controls. *Scheduling* refers to the setting of sensors to remain on for a certain period of time after an occupant leaves the area; this minimizes the number of times the lights cycle on and off. A common delay in the shut-off time setting after an occupant departs a room is between three and five minutes. Delays for restrooms are usually set at five minutes. Settings for office area sensors depend on the nature of the occupancy; some locations are repeatedly entered and exited over the course of an hour and would require a long delay to be effective. Other functional areas are entered infrequently, and a shorter delay of three minutes is effective.

Tuning refers to the sensitivity of the photocell switch. Ideally, the lights should turn on only after the natural illumination level in an area falls below the ASHRAE-90.1-2001 recommended illumination for that particular functional area type.

For rooms equipped with daylighting, install combination OSS/photocell switches. This switch type prevents use of artificial illumination when sufficient natural light is available in the room. As illustrated in Table 8-14, the selection of appropriate lighting controls provides fairly significant energy savings when compared to manual switching.

8.14.2.5 Emergency Exit Signs and Safety Lighting

Safety lighting refers to lighting that allows building occupants to move through or exit areas without endangering themselves or others. Safety lighting includes emergency exit signs, as well as backup and emergency lighting. For each type of lighting, Fort Hood requires the designer to use low-energy safety lighting fixtures that use high-efficacy light sources. Emergency exit signs should use only light-emitting diode (LED) lighting systems.

Backup or emergency lighting for hallways/stairways and access points used 24-hours-per-day, 7-days-per-week should be of the highest efficiency possible. Hallway/stairway lighting must contain entirely T5 fluorescent lamping and appropriate energy-efficient ballasts having a ballast factor of between 0.85 and 1.0.

Backup lighting often refers to the lighting system that comes on automatically if a power failure occurs. The term "emergency lighting" means the same thing in some references, while others use the term to label the lighting used 24 hours per day 7 days per week to provide sufficient illumination to access the hallways.

8.14.3 Water-using Fixtures and Mechanical Systems

Metering and Leak Detection

Metering reduces water consumption by assisting with identification of system leaks. The 2005 Fort Hood Water Management Plan reports that an estimated 10% of the Post's total water consumption is lost due to system leaks. While leak detection for the existing system can be implemented system-wide, a more efficient method of leak detection is to install water meters and track water usage to help identify and locate the presence of a leak as soon as practical. Fort Hood

Executive Order 13123, Greening the Government through Efficient Energy Management, mandates an aggressive policy for reducing potable water consumption at federal facilitates. Fort Hood is committed to the implementation of water conservation measures. Measures are currently being implemented at Fort Hood to reduce potable water demand, the amount of sewage generated, and energy consumption (heated water). The water conservation benefits of fixtures and systems using less water meet Fort Hood's 25-Year Sustainable Goal of reducing potable water consumption.

An inventory of Fort Hood water consumption (see box) indicates changes in equipment and practices in Housing (Army Family Housing and unaccompanied personnel housing [barracks, bachelor officers' quarters, and base enlisted quarters]) offer the greatest opportunities for potable water reduction. Sustainable practices and equipment changes that can be used to reduce potable water consumption in all of the listed sectors (except water loss due to leakage) are discussed below. All hot and cold water pipes shall be insulated.

Inventory of Fort Hood Water Consumption

FY03 potable water consumption at Fort Hood was approximately 2,359 million gallons. Water use by sector was estimated as:

- Housing: 28%
- Commercial: 25%
- Irrigation 20%
- Water Loss 10%
- Industrial: 17%

At Fort Hood all plumbing work shall be conducted in accordance with the 2003 International Plumbing Code.

8.14.3.1 Indoor Fixtures and Appliances

The 1992 Federal Energy Management Plan (FEMP) establishes water consumption specifications for various common fixtures. Table 8-15 summarizes these performance requirements in addition to any Fort Hood specific performance requirements for the indoor fixtures and appliances. The requirements are for all new construction and renovation projects. Note: It is important to choose products that have standardized replaceable components for best long-term performance. Fort Hood requires specific fixtures in association with the following two settings:

- **Domestic setting** refers to places where soldiers and families live; and
- **Institutional setting** refers to all other land use activities (e.g., office, commercial, industrial, food establishments, etc.)

Fort Hood Standards

Shower Heads. FEMP (1992) defines low-flow showerheads as providing a maximum flow of 2.5 gallons per minute (gpm). In addition, Fort Hood requires maximum showerhead flows of 1.5 gpm at 80 pounds per square inch (psi) for all domestic and institutional new construction and renovation projects. While flow restrictors can be installed in existing showerheads, many do not achieve the required 1.5 gpm flow rates, and they tend to have a lower user satisfaction.

Faucets. Faucet flow rates vary by application. Common faucet applications are bathroom and restroom washbasins, kitchen, and industrial/work rooms.

Water-use minimization in domestic and institutional faucet applications (bathroom and kitchens) is best achieved by using low-flow faucets. Kitchen faucets should have maximum flow rates between 2.2 and 2.5 gpm. In washrooms, select faucets with a flow between 0.5 and 1.25 gpm. Use pressure-compensating faucets to attain a maximum water pressure of 80 psi. Faucet aerators may be used to retrofit existing faucets not meeting the Fort Hood requirement.

A Customer Service Inspection must be completed prior to providing continuous water service to new construction; on any existing service when the water purveyor has reason to believe that cross-connections or other potential contaminant hazards exist; or after any material improvement, correction, or addition to the private water distribution facilities. Government approval of the inspection is required. For additional information, contact 254 287-4256.

28% of Fort Hood's annual potable water consumption is used by housing for domestic purposes; primarily bathing, cooking, toilet operations, clothes washing, and dish washing.

On-demand faucet: Faucet that dispenses water only when a user is present to use the water. Controls for on-demand faucets include mechanical and electronic sensors.

Metered faucet: Faucet set to deliver a preset amount of water then shut off automatically.

Self-closing faucet: A faucet that automatically shuts off after operating for a programmed amount of time or when the user moves away from the fixture.

Table 8-15
Water Fixture Performance Standards Specified by the Federal Energy Management Program

Fixture Type	FEMP (1992) Equipment Option	Description	Comments
Shower Heads	2.5 gpm with aerator, or 2.2 with laminar flow	Fixtures supply a maximum water flow.	Shower heads of 1 to 2.5 gpm work well and provide more conservation
Faucets	Temporary shut-off valves	Mechanically eliminates water from flowing when not needed.	Requires operator to conduct shut-off effort to be effective.
	Automatic shut-off valves	Infrared or ultrasonic sensors that detect the presence of someone's hands and shut off water when hands are removed. Sensors that comply with the American with Disability Act.	Devices need to be properly set to operate effectively. Power required for some fixture types.
Toilets	Infrared or ultrasonic sensors	Installed on flush-valve style toilets to automatically activate flushing.	Devices need to be set properly to avoid multiple flushing. Power required.
	Early closure or valve insert or replacement devices	Reduce flush volumes to 1.6 gpf.	Often require frequent replacement or adjustment; thus may not be appropriate for many federal facilities.
	Valves and porcelain specifically designed to use 1.6 gpf		Use requires site-specific evaluation of existing waste lines, water pressure, distance, usage, settling, and types of users (employees, residents, occasional members of the public, high visitor populations, etc) to determine the appropriate models for a specific site.
	Composting toilet	No specifications	Best for remote situations; not practical in conventional buildings.
Urinals	1 gpf flusher		Provides best results when equipped with automatic flushing device.
	Waterless urinals	No specifications	Proven track record; lower daily maintenance effort, but does require replacement of interior element.

Key:
gpf = Gallon(s) per flush.
gpm = Gallon(s) per minute.
Source: FEMP 1992.

In institutional restroom settings, to achieve water-use reduction, Fort Hood requires automated controls to shut off water after a set use period or when a user moves away from a fixture. Other controls such as foot-activated units help achieve water-use minimization in institutional kitchen and industrial/work room faucets. Automated faucet controls not only limit the amount of water used, but they also prevent disease transmission because they do not need to be handled to operate. Automatic shutoffs are not required for domestic uses. Automated controls to shut off water are not required for residential settings.

Note: All electronic control systems need a power supply; generally, power supplies in new construction are hardwired, while most retrofitted installations are battery operated. Either system requires ongoing purchase of power or batteries, or the additional cost of a permanent energy supply such as a solar power system. In addition to battery costs for battery-powered sensors, these units will not function if the battery does not have sufficient power; thus, they require maintenance in order to function. These systems typically require an electrician as well as a plumber when maintenance problems occur.

Toilets and Urinals. According to *Greening Federal Facilities* (May 2001), toilets account for almost half of a typical building's water consumption; thus, reducing or eliminating the volume consumed by these fixtures offers a significant water reduction opportunity.

Toilets. Fort Hood requires, at a minimum, following of the FEMP standards for water-flushing volumes in toilets (1.6 gallons) in domestic and institutional settings. Another toilet type with fairly well-developed technology is the composting toilet, which uses a limited amount of water. There are two types of compost toilets. The self-contained units combine the commode and the composting compartment in a single unit. The split units have separate commode and composting components. The cost is comparable to many septic systems and is considered a practical alternative when there is no central wastewater system. In remote areas of the installation, Fort Hood considers the composting toilets acceptable.

Photo: Sheila Hayter, ©DOE/NREL.

Waterless urinals save on water costs as well as building construction costs because they do not require installation of cold water supply lines.

Low-flow toilets: Toilets using 1.6 gallons per flush (gpf) or less to operate.

Urinals. Fort Hood requires, at a minimum, following the FEMP standards for water-flushing volumes and urinals (1 gallon). However, Fort Hood is already using and committed to the use of waterless urinals. As such, waterless urinals are the current standard for new construction and major projects occurring at Fort Hood. In accordance with the Memorandum: *The Army Standards for Urinals (April 5, 2006)*, non-water-using urinals are the Army Standard for new construction and major repairs effectively immediately for FY10 and beyond. MILCON projects or major repairs not yet solicited. Retrofits will replace urinals using more than 1 gallon per flush if criteria are met in accordance with Water Urinals, Technical Evaluation, March 2005 (or as updated). Maintenance consists of replacing the cartridges and the liquid.

Automated toilet and urinal flushing devices include sensing motion (ultrasound) and heat (infrared) and timers that help eliminated double-flushing are required by Fort Hood. Like faucets, these units require a power supply that is either battery operated or hardwired. Battery-operated controls will not function when a battery's power has been depleted; thus, routine maintenance is required.

For consistency with Cleaning Service Contracts it is recommended that the following bathroom accessories are selected when purchasing new equipment:

- Toilet Tissue Dispenser: Georgia-Pacific model #56T, Eclipse Quick View, 9 inch Twin Jumbo Bath Tissue Dispenser, Color: Smoke.
- Paper Towel Dispenser: Georgia-Pacific model #84T, Eclipse Quick View, Lever Control, Roll Towel Dispenser, Color: Smoke.

For additional information related to toilet accessory requirements, contact the DPW.

Clothes Washers and Dishwashers. Fort Hood requires the use of appliances on the installation that have earned the Energy Star® certification. Energy Star appliances meet strict energy efficiency guidelines set by the U.S. EPA and U.S. Department of Energy. Energy Star appliances not only operate on a reduced amount of energy, but many water-consuming Energy Star appliances also operate on a reduced amount of water compared to equivalent non-Energy Star-certified appliances. These appliances will reduce water volume consumed, as well as the amount of heated water.

Horizontal-axis clothes washing machines use even less water, and thus less heated water, than do many of the Energy Star-certified vertical-axis washers. Use of Energy Star horizontal axis washers is not required by Fort Hood, but their use is encouraged.

Garbage Grinders. Garbage grinders (disposals) are not permitted unless otherwise approved by the Chief of Master Planning with a justification.

Plumbing Compliance Requirements

1. Backflow Prevention: Backflow prevention assemblies shall be installed in accordance with the requirements of the TAC (Texas Administrative Code) Title 30 Environmental Quality, Part 1 TCEQ, Chapter 290 Public Drinking Water, Sub Chapter D Rules and Regulations for Public Water Systems, Rule 290.44 Water Distribution Rule 290.46, and 290.47. The TCEQ (Texas Commission on Environmental Quality) administers all rules of the TAC. All backflow prevention assemblies that are installed on Fort Hood, Texas. will be tested upon installation by a licensed backflow assembly tester certified by the TCEQ. The original signed and dated test reports will be submitted to the DPW, Chief of Environmental Division, Bldg. 4219, 77th and Warehouse Avenue, Fort Hood, TX.

For permanent installations, backflow assemblies are to be installed above grade in Hot Boxes. The backflow assemblies will be installed not less than 36 inches above the ground, not greater than 42 inches above the ground, and will be located not less than 12 inches from any wall. The assemblies will not be installed where they obstruct access to any mechanical components or near electrical components.

Backflow prevention tests- EMs and Designers: Please make sure specifications for all projects that are not yet awarded require the Contractor to test backflow prevention assemblies as required by 31 TAC 290.44(h). At the completion of inspection, the Contractor should be required to submit a Test Report in compliance with Appendix F of Chapter 290. Also, verify the products specified as capable of being field tested, i.e., have test ports, cocks, etc., as needed.

2. Customer Service Inspections: The Texas Commission on Environmental Quality (TCEQ) Rules and Regulations for Public Water Systems requires a "customer service inspection certification (example, Encl 2) be completed prior to providing continuous water service to new construction, on the existing system when the water purveyor has reason to believe cross-connections or other unacceptable plumbing practices exist, or after improvements, corrections, or additions to plumbing facilities." For additional information contact DPW.

Personnel qualified to make the certifications are plumbing inspectors licensed by the Texas State Board of Plumbing Examiners, certified waterworks operators, and licensed plumbers (for single-family residential services).

The customer service inspection records must be retained 10 years and be available for commission review. The original inspection report will be submitted to the DPW, Chief of Environmental Division, Bldg. 4219, 77th and Warehouse Avenue, Fort Hood, TX.

NOTE: For new construction involving plumbing or mechanical systems; or for material improvement, correction, or addition to plumbing or mechanical systems. Not applicable for other projects, such as non-building projects.

Certification Requirements

The Rules and Regulations for Public Water Systems (TCEQ publication number RG-195) require a customer service inspection certification before providing continuous water service for the following conditions: New construction involving plumbing or mechanical systems; or Material improvement, correction, or addition to plumbing or mechanical systems.

The Customer Service Inspection certifies that for work done under this contract:

A. No direct connection between the public drinking water supply and a potential source of contamination exists;

B. No cross-connection between the public drinking water supply and a private water system exists;

C. No connection exists which would allow the return of water used for condensing, cooling industrial processes back to the public water supply;

D. No pipe or pipe fitting which contains more than 8.0 percent lead exists in private water distribution facilities installed on or after July 1, 1988; or

E. No solder or flux which contains more than 0.2 percent lead exists in private water distribution facilities installed on or after July 1, 1988.

3. Sewage systems: Sewage systems will be designed for compliance with TAC Chapter 317 Design Criteria for Sewage Systems, which sets minimum standards necessary for domestic wastewater treatment systems to function properly and meet requirements for effluent quality. The criteria also contain certain safety standards.

For sanitary sewers:

- Use SDR-26 PVC pipe for sewer piping. PVC will be used rather than metal underground, to avoid requirement for cathodic protection (A waiver is required).
- A tracer wire is not required with a sewer pipe system.

- Sewer mains will be a minimum of 8-inches in diameter.
- A buildings sewer connection will use at minimum, a 6-inch diameter pipe to allow maintenance personnel to 'jet' a plugged sewer line.
- Two-way cleanouts will be provided at the buildings sewer connection and every 150 feet along a sewer branch from a building.
- Exact coordinates will be provided to an accuracy of 6 inches and invert elevation to an accuracy of 1/10 foot for the sewer connection to a building. This information will be provided for both the plumbing and civil drawings.
- A manhole will be provided at every change of direction of the sewer line and every 400 feet.
- Use a drop manhole if elevation change is more than 18 inches (per standard criteria).

The use of sewer lift stations will be minimized. If a lift station is required:

- A packaged unit assembled of coated metals, that will not corrode easily, will be used.
- An audible and visible alarm will be provided in case of a malfunction.
- The lift station shall be accessible to DPW service trucks.
- In remote areas, an alarm shall be installed that transmits an FM signal to DPW.
- If the location is remote and away from a main road, a gravel surfaced road will be built to the lift station.

4. Drinking Water Systems: Drinking water systems will be designed for compliance with TAC Chapter 290, Public Drinking Water, which provides for, among other requirements, rules, and regulations for public water systems.

5. Plumbing Work: All plumbing work shall be conducted in accordance with the 2003 International Plumbing Code.

8.14.3.2 Water-using Mechanical Systems

Hot Water Heaters. While heat pumps have traditionally been used for space conditioning they are now also being used for electric water heating. They are usually three times more efficient than electric resistance water heaters—meaning that they can produce the same amount of hot water for one-third the amount of electricity. As such, Fort Hood supports the use of stand-alone heat pump water heaters (HPWH). HPWH use the heat from the surrounding room air and cool and dehumidify a space. This is a benefit during the cooling season and a drawback during the heating season.

Steam boiler blowdown: Periodic release of water from the boilers to remove accumulated sediments and solids.

As a contribution to the whole building's potable water demand, consider using blowdown water for other non-potable water purposes, such as irrigation.

Fort Hood also supports the use of tank-less hot water heaters for housing and individual sinks and shower applications. Tank-less water heaters provide hot water at a preset temperature when needed without storage, thereby reducing or eliminating standby losses. Large units intended for whole house water heating are located centrally in the house, while in point-of-use applications, the water heater usually sits in a closet or under a sink. Tank-less water heaters typically use 10 to 20 percent less energy than tank types and can last twice as long.

Cooling Systems. Fort Hood operates and maintains 49 cooling-tower systems. Significant water can be consumed by cooling systems using cooling towers. Water is lost to drift, evaporation, and bleed-off, and must be replenished. Most cooling systems use potable water. Presently, there are no single-pass cooling systems at Fort Hood. All of the larger (100-ton or more) cooling towers have been retrofitted to recycle cooling water an average of four times prior to discharge to the sewer; however, these systems use potable water.

Single-pass cooling systems are not permitted for use in any future building cooling systems. A closed-loop system using rainwater or graywater instead of potable water or the use of surge tanks for cooling and heating systems to eliminate on-demand potable water use should be considered when designing building cooling systems. Furthermore, the use of graywater or rainwater for makeup water instead of potable water should be considered. Graywater and rainwater use are discussed further in Section 8.14.4.

Boilers. Steam boiler blowdown operations result in the need for makeup water replenishment. Following are acceptable sustainable water replenishment options to consider when a designing a new system or a system retrofit:

- Add a condensate return system to collect and reuse blowdown water.
- Add an expansion tank to collect boiler blowdown water and enable it to cool, then be re-entered into the system.
- Use a heat exchanger in this system to capture heat in blowdown water and use it to preheat boiler feed water and to cool the blowdown water.
- Graywater and rainwater use should be considered for water replenishment sources.

8.14.4 Water Reuse Systems and Applications

Executive Order 13123, Greening the Government through Efficient Energy Management, mandates an aggressive policy for reducing potable water consumption at federal facilitates. Fort Hood is committed to evaluating alternative water sources for functions that may not require potable water. As such, designers of new construction and renovation projects at Fort Hood are required to consider how water reuse processes discussed in this section can be incorporated and used in their project design or future designs within the project area. The conservation benefits of water reuse meet Fort Hood's 25-Year Sustainable Goal of reducing potable water consumption.

8.14.4.1 Water Reuse Systems

Rainwater Harvesting. Fort Hood supports the use of rainwater harvesting, the process of intercepting stormwater runoff and putting it to beneficial use. Rainwater is usually collected or harvested from rooftops, concrete patios, driveways, and other impervious surfaces. Buildings and landscapes shall be designed to maximize the amount of catchment area, thereby increasing rainwater harvesting possibilities. Intercepted water then can be collected, detained, retained, and routed for use in vehicle washing, cooling systems, and toilets. When used for washing, only a sediment filter is needed to prepare it for use. Cooling system water may require treatment for biological organism growth. Water storage requires some basic measures to prevent insects, such as mosquitoes, from breeding.

Photo: Robb Williamson, ©DOE/NREL.

Rainwater collection systems such as this one can provide water for toilet operation, boiler and chiller make-up water, and irrigation.

Intercepted stormwater shall also be collected, slowed down, and retained or routed through the site landscape using microbasins, swales, and other stormwater harvesting structures discussed in Section 10.4.2 "Low Impact Development." Incorporating rainwater harvesting into site landscaping has the added benefits of:

- Combining stormwater detention/retention, landscape buffers, and a visual screen into a single feature;
- Reducing landscape irrigation needs; and
- Lowering energy requirements by shading buildings with vegetation watered with harvested stormwater.

The Fort Hood area receives an average of 31 inches of rain per year. A 2,000-square foot area can capture nearly 36,000 gallons of water annually, which would fill 100 gallons per day in water needs. Further details about rainwater harvesting can be obtained from the state of Texas's publication Texas Guide to Rainwater Harvesting. Another good source of information is the City of Tucson Water Harvesting Manual.

Storm water retention ponds are a means of collecting and storing water for irrigation use.

Graywater. Fort Hood supports the use of graywater systems for irrigation and other water uses in accordance with its uses as regulated by the State of Texas. Graywater is specifically wash water. That is, bath, dish, and laundry water excluding toilet wastes and free of garbage-grinder residues. When properly managed, graywater can be used to meet non-human contact water needs, such as irrigation and building cooling equipment operation. Graywater systems offer the opportunity to irrigate regardless of season or any prevailing drought conditions because the water is usually generated daily. Graywater systems vary from simple, low-cost systems to highly complex and costly systems. These systems reduce water consumption and sewerage charges.

Graywater use requires storage and additional plumbing components. Furthermore, the graywater tank may require a treatment system to maintain control of microbiological organisms (pathogens that may be present in the water.) Human contact with graywater should be avoided because of these pathogens. Pathogens also make graywater use appropriate only for subsurface, not surface, irrigation systems. Graywater storage should be limited to control microbiological organisms and because it

produces unacceptable odors. Use a filtration system for graywater that is easy to clean; filter malfunction is a common problem with graywater systems.

Effective January 6, 2005, the Texas Commission on Environmental Quality (TCEQ) adopted implementing standards for graywater use under Chapter 210 (Use of Reclaimed Water) and Chapter 285 (Onsite Sewage Facilities) of the Texas Administrative Code.

Installation of a rainwater capture system as a water source for vehicle washrack system should be considered at all new and replacement washrack construction projects.

8.14.4.2 Water Reuse Applications

As mentioned, Fort Hood is committed to evaluating alternative water sources for functions that do not necessarily require potable water. Common uses of recycled water are listed below and should be considered during the design of any future construction or renovation activities at Fort Hood.

Irrigation (see Section 10.4.3). Irrigation needs are best met from rainwater use, as human contact with either the water itself or the irrigated area is not a concern. However, a subsurface graywater irrigation system is also a safe and effective method for irrigation. A site design that incorporates low-impact development (LID) processes (see Section 10.4.2) for stormwater management and plant irrigation is a water reuse application strongly supported for use at Fort Hood.

Cooling Water (see Section 8.14.3.2). Rainwater, once filtered for particulate matter, can serve effectively in a cooling-tower system. Graywater use is better suited to cooling systems that do not loose water to evaporation, as this minimizes the potential for human contact.

Boilers (see Section 8.14.3.2). Steam boiler blowdown operations (periodic release of water from the boilers to remove accumulated sediments and solids) result in the need for boiler makeup water replenishment. Makeup water used in most boilers is potable water; however, use of potable water alternatives for makeup water is feasible in many cases.

Photo: Brendan Osban, ©DOE/NREL.

Capture, filtration, and reuse of boiler blowdown water can significantly reduce potable water consumption by heating systems.

Toilet and Urinal Flush Water. Potable water is usually used for flushing. Due to the non-human contact use of flushing, graywater is an appropriate substitute for the potable water use. Rainwater is also appropriate.

8.14.4.3 Water Reuse Considerations

When considering water reuse systems and their application, each project must be evaluated on its own merit. There are, however, common aspects to consider when evaluating the system and its application:

- What are the water reuse opportunities;
- What is the volume demand for reused water;
- What volume of reuse water can be collected at a facility;
- How much storage capacity is needed;
- What type of treatment system is needed and where will it be built;
- Are any public safety concerns associated with the systems, and
- What are the implementation costs, operational and maintenance costs, and payback period?

8.14.5 Renewable Energy Systems

Building orientation is crucial to both passive and active solar design.

Fort Hood is committed to the use of renewable energy systems as part of its overall energy management program. The energy management program is aimed at reducing waste and costs while preserving natural resources and ensuring that Fort Hood will always be mission-ready. A successful energy management program requires the effective implementation of proven energy conservation techniques, the use of new energy-efficient equipment, integration of passive solar design features, and the application of active renewable energy systems. Onsite generation of renewable energy also improves power reliability and reduces reliance on the local power distribution grid. The benefits of renewable energy systems meet Fort Hood's 25-Year Sustainable Goals of using sustainable products and services to minimize waste and environmental impact, of reducing impacts on regional air quality, and of using infrastructure systems and energy systems that are sustainable.

8.14.5.1 Passive Solar Design

Passive solar building design encompasses a wide range of strategies and options resulting in energy-efficient buildings and increased occupant comfort. Solar concepts can be divided into two broad categories: (1) those that use the energy from the sun to directly impact the lighting needs of the

building (i.e., daylighting), and (2) those that use the energy from the sun to directly or indirectly

impact the thermal needs (heating and cooling energy use) of the building. A properly designed passive solar commercial-type building is not anticipated to completely eliminate the need for the auxiliary energy systems used to heat, cool, or light the building. Because of the size of most buildings, large internal loads, and diverse use patterns, passive solar systems are expected to supplement the energy systems of the building and provide significant energy savings.

In a passive solar building, the solar components are integral parts of the building itself rather than separate subsystems. Building orientation is crucial to both passive and active solar design. Ideally, buildings should be aligned on an east-to-west axis, and the shape should be long and narrow, with the longest sides facing south and north to maximize available daylight and solar access while controlling unwanted solar gain. In general, passive solar buildings that take advantage of the climate are less tolerant to changes in orientation and shape than are climate-rejecting buildings. To achieve the most solar benefits, the majority of window glazing should be on the south side. If it is necessary to shift the building orientation from true south, a shift within 20 degrees will have minimal impact; however, as the orientation shifts more drastically, the building will significantly lose solar benefits. It is crucial to understand the details of the sun's position in the sky throughout the year when designing for solar access. The sun's angles at three representative times of the year for buildings on Fort Hood are shown on Figure 8-2.

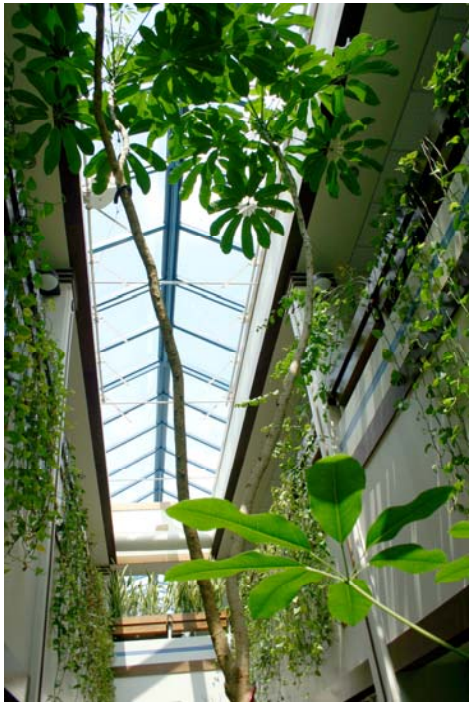
Daylighting. Daylighting is the technique of using natural light from windows, skylights, and other openings to supplement or replace a building's artificial lighting system. When applied properly, daylighting can reduce a facility's lighting costs. When applied improperly, however, it can not only lead to inappropriate light levels, but can also raise the building's cooling costs by introducing high levels of solar heat into the building's interior. It is the easiest system to accommodate and shall be considered for all new construction unless strong programmatic function does not allow daylight.

Climate-rejecting building: A building that relies totally on mechanical means for heating, cooling, and lighting. The natural environment is not used to help reduce auxiliary energy use.

©Jacobs.

The effective use of daylighting and indirect lighting helps create a pleasant interior environment.

Light-colored surfaces within this daylit school help reflect daylight into the room.



In multi-story commercial-type buildings, the most difficult location to daylight is the center of the building, called the building core. The use of an atrium is a core daylighting strategy that opens up the center of the building so that it can be daylit.

Suggested room surface reflectances to maximize the benefits of daylighting:

Ceilings: > 80%
Walls: 50%-70%
Floors: 20%-40%
Furnishings: 25%-45%

Source: DOE Energy Efficiency and Renewable Energy Building Technologies Program.

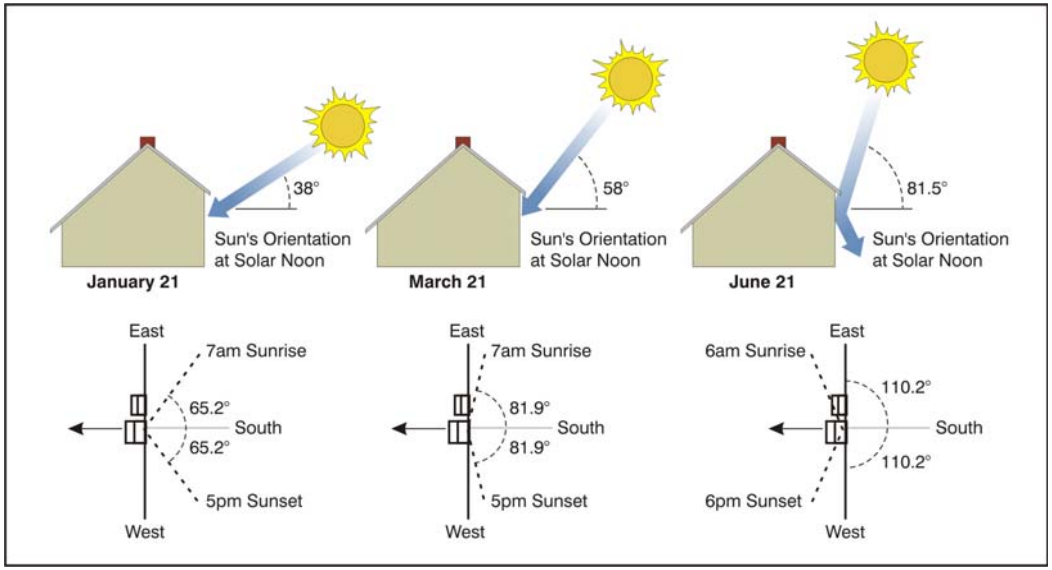


Figure 8-2 Solar Access Angles for Buildings at Ft. Hood

Decisions made early in the design process have a significant impact on the level of daylighting and the eventual energy consumption of the finished building. Key factors that affect the amount of daylight that can penetrate into a space are:

- The visible sky angle;
- The width and depth of the room;
- The net window area;
- The visible transmittance of the glass; and
- The reflectance of the surfaces inside the room.

Daylighting systems consist of collection and distribution components. There are two basic types of daylighting systems (Figure 8-3) that should be considered for use at Fort Hood:

- Sidelighting; and
- Toplighting.

The desired amount of daylight for a space differs depending on the task occurring in that daylit space. Daylit buildings often have several daylight zones with differing target light levels; therefore, building designers and occupant managers should try to group tasks by similar lighting requirements and occupancy patterns. Within the spaces that can use daylight, try to place the most critical visual tasks in positions near the window.

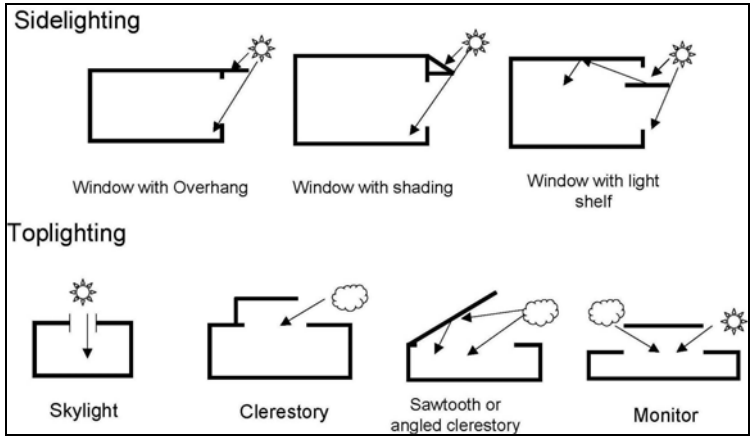


Figure 8-3 Types of Daylighting

In multi-story buildings or where roof monitors are not possible, lightshelves on south-facing windows can be an effective daylighting strategy for rooms up to 20 feet deep. Do not use lightshelves on northern exposures.

Photo: Jim Yost, ©DOE/NREL.

This south-facing clerestory provides abundant daylighting, as well as allows some solar heat gain into the interior space in the winter when the sun is low in the sky.

Photosensing, shading, glare, as discussed below, are all components of daylighting.

Photosensing Controls. An effective daylighting system shall include photosensing controls that dim or turn off lights when sufficient natural light is available to maintain desired lighting levels. Control systems shall take into account the different patterns of occupancy and make the best use of controls, rather than simply aiming to minimize energy consumption. Sensors shall be mounted in a location that closely simulates the light level at the work plane. Motorized blinds equipped with a photosensor that automatically opens and closes the blinds can be used in public areas where individual control of light levels is not desired; however, individual occupants shall have control over the task lights in their own work space.

Shading. Shading is an important consideration in daylighting to minimize unwanted heat gains. South-facing windows can also be shaded using properly sized roof overhangs and landscaping features (i.e., deciduous trees; see Appendix I). Roof overhangs or retractable awnings on the south side can be easily sized to shade in the summer when the sun path is high in the sky and to allow sun in the winter when the sun path is low. For retractable awnings, evaluate the use of motor controls

For a typical office, 30 feet is the maximum depth of daylight penetration from sidelighting. Depending on their geometry, greater penetration may be possible in high-bay buildings like warehouses or hangars.

An effective daylighting system should include photosensing controls that dim or turn off lights when sufficient natural light is available to maintain desired lighting levels (see Section 8.14.2.4).

©Jacobs.

Properly sized overhangs block summer sun, but allow winter sun in. The width of the overhang depends on the latitude of the site and the orientation of the window.

equipped with photosensing switches to enable automatic awning extension during times of high-angle sunlight. Although external shading is the most effective means of intercepting excessive solar heat gain before it enters the building, internal sunshading devices, such as insulating shutters, opaque and semi-opaque shades, film shades, draperies and Venetian blinds, can be effective means of minimizing glare and improving perimeter zone comfort if properly adjusted. North-facing windows receive predominately diffuse solar radiation and indirect daylight and, therefore, do not need overhangs.

East- and west-facing windows are the most difficult to shade. Early morning and late afternoon sun rays approach perpendicular to these windows causing excessive heat gain and visual glare; therefore, the use of east- and west-facing windows should be minimized. When these windows cannot be avoided, carefully size and place them for daylighting and view purposes only. Use a combination of horizontal louvers and vertical fins to shade these windows as much as possible.

Skylights can also be used, but should be designed to avoid overheating. Skylights that incorporate motorized, louvered systems that seasonally and hourly adjust to allow the optimum amount of radiation to enter the glazing should be selected. Additionally, a means to reduce glare and diffuse the radiation once inside the space must be considered.

Glare. Glare control is one of the most common failures in daylighting strategies. Reflected light makes a significant contribution to the quantity of light available within a building. The amount of light reflected depends on the reflectance of the surfaces. A white roof surface can reflect considerable daylight into roof monitors and light-colored interior finishes can help reflect daylight into the building interior. By diffusing light and eliminating direct-beam radiation into an occupied space, potential glare problems can be reduced.

Important Note: Computer modeling software can be used to simulate daylighting conditions. Daylighting software produces continuous daylight contours to simulate the daylighting conditions of interior spaces and to account for combined effects of multiple windows within a daylit space. The results of the daylighting models are then input into a building energy simulation package (see beginning of Section 8.14) in order to compare design options and analyze energy consumption.

Passive Solar Heating and Cooling. Passive solar design refers to design and material choices that use or avoid the sun's heat to promote thermal comfort and energy conservation and reduce the need for mechanical heating, cooling, and ventilation systems. Integration of passive solar heating and cooling, along with daylighting, into a building can yield considerable energy benefits and added occupant comfort.

Passive Heating. Two types of thermal mass systems should be considered for passive heating at Fort Hood: (1) solar-heated mass such as floors that are located in the building's interior and (2) thermal storage walls (i.e., Trombe walls) located outside the building.

In the first system, sunlight comes directly through south-facing windows into the space to be heated. The building materials struck by the sunlight are thermal mass materials – concrete/tile floors, masonry walls, or even strategically placed containers of water. When the space cools in the evening, the heat migrates to the cooling spaces either directly (radiation) or by air movement across the surface of the material (convection). These materials absorb, store, and distribute heat. The direct-gain system is able to use 60 to 75% of the sun's energy striking the windows.

In the second system, thermal storage walls (i.e., Trombe walls) located outside the building are in direct contact with sunlight and absorb heat. The heat moves throughout the walls providing additional heat to interior areas. To absorb and release heat on a daily cycle, the mass must be exposed to the interior space and not covered with carpets, wallcoverings, or fireproofing. Trombe walls are most appropriate for providing supplemental heat to facilities with low levels of thermal control, such as garages and warehouses. The main disadvantage of the system is that exterior walls become a heat loss source during extended overcast days.

Like any system, the elements of passive solar heating system discussed above must be designed in consideration of summertime conditions, when heating is not required. For the interior mass system, the design must allow for keeping the sunlight off the windows via the overhang in the summertime, while in the winter, when the sun is much lower in the sky it can easily skirt under the building's brow. In the thermal wall storage system, Tromble walls should be shaded from summer sun.

A Trombe wall is a sun-facing wall built from material that can act as a thermal mass such as stone, concrete, or adobe combined with an air space, insulated glazing and vents to form a large solar thermal collector.

During the day sunlight shines through the glazing and hits the surface of the thermal mass, warming it by absorption. The air between the glazing and the thermal mass warms and rises, taking heat with it. The warmer air moves through vents at the top of the wall and into the living area while cool air from the living area enters at vents near the bottom of the wall.

A light shelf is a horizontal light-reflecting overhang placed above eye-level with a transom window placed above it. This design, which is most effective on southern orientations, improves daylight penetration, creates shading near the window, and helps reduce window glare.

Photo: Thomas Wood, ©DOE/NREL.

The south exposure of the new Visitor Center at Zion National Park provides a well-suited location for Trombe walls that provide most of the building's heat as well as a 7.2 kW photovoltaic array provides a significant portion of the electricity needed by the building and serves as an uninterrupted power supply for use during power outages.

Photo: Jim Yost, ©DOE/NREL.

A transpired solar collector was installed in the entire south wall area of this Colorado warehouse. Solar energy absorbed by the dark wall provides heated ventilation air to the warehouse.

Another passive solar heating technology appropriate for use at Fort Hood is a transpired solar collector. This is a simple solar collector consisting of a dark, south-facing, perforated, metal surface that also acts as the building's exterior protective skin. The sun heats the dark, perforated wall. A centrally located fan at the top of the wall draws air through the perforations. The air is heated as it travels up behind the heated wall. The fan then distributes the warm air into the interior space. These collectors are most effective on the south-facing side of a building. Transpired solar collectors are particularly effective in areas requiring large amounts of heated ventilation air during the daytime hours, such as warehouses or garages.

Passive Cooling. Cooling measures are more important than heating in the region of Fort Hood. The first step for cooling is minimizing cooling loads by providing appropriate external window shading and glazing. Other passive solar cooling strategies include natural ventilation, radiative cooling, dehumidification, and ground coupling. Effective passive cooling, however, is difficult to achieve at Fort Hood due to frequent high humidity, especially in the spring and fall and at night in summer. Because of nighttime cloud cover, heat does not dissipate well to the night sky.

- Shading. The most important passive cooling strategy, and the easiest to achieve at Fort Hood, is shading. Movable awnings, roll-down shades, or shutters can help shade interior spaces. Unshaded paved areas should be minimized to reduce the amount of heat absorbed and stored near buildings. The proper placement of plantings can also be beneficial in providing a wind barrier in winter or channeling summer breezes to enhance natural ventilation (see Section 10).

- Natural Ventilation. In Central Texas, prevailing summer breezes come from the south and southeast off the Gulf of Mexico. This phenomenon provides an opportunity for good ventilation with the following strategies:

  - Place operable windows on the south and north sides. If possible, place windows on more than one side of a room. If a room can have windows on only one side, use two widely spaced windows instead of one window.

  - Add wing walls next to windows on the windward side of the building to direct breezes into windows. Wing walls are vertical solid panels placed alongside windows perpendicular to the wall on the windward side of the building.

- Create thermal chimney effect to draw air into, up, and out of the building, ventilating the structure

©Ft. Hood

Landscaping can help shade the building envelope and reduce cooling loads.

8.14.5.2 Active Solar Systems

Active Solar Collector Systems. Active solar collector systems take advantage of the sun to provide energy for such things as domestic water heating, pool heating, ventilation air preheating, space heating, and lighting. Active solar systems should be integrated with a building's design and systems only after passive solar and energy-conserving strategies have been employed to reduce the building's overall energy needs.

Domestic hot water heating is generally the most economical application of active solar systems. The demand for hot water is fairly constant throughout the year, so the solar system provides energy savings year-round. Solar hot water system collectors either can be mounted directly on the building or rack-mounted near the building. Installation is usually simpler and the collectors are more attractive if they are integrated into a roof surface or installed flush with it. Optimally, the vertical tilt angle of the south-facing collectors should be equal to the latitude of Fort Hood (31 degrees) for year-round uses.

An active solar water heating system can be designed with component sizes large enough to provide heating for pools or to provide a combined function of both domestic water and space heating. Space heating requires a heat-storage system and additional hardware to connect with a space heat distribution system. An active solar space heating system makes economic sense if it can offset considerable amounts of heating energy from conventional systems over the life of the building or the life of the system.

Photo: Robb Williamson. ©DOE/NREL.

When natural ventilation is not enough to cool the air on hot summer days, cooltowers can help. Water is pumped over pads located at the top of the tower. The water evaporates and cools the air which then falls through the tower and exits through the large openings at the bottom of the tower.

Active solar systems used to provide parking lot lighting on Fort Hood.

Photo: Kiss + Cathcart – Architects, ©DOE/NREL.

The PV curtain wall on 4 Times Square extends from the 35th to the 48th floor on the south and east walls of the building, making it a highly visible part of the midtown New York skyline. The building's photovoltaic skin uses thin-film PV panels to replace traditional glass cladding material.

Photovoltaics Systems. Photovoltaics (PVs) convert sunlight to electricity using semiconductor devices called solar cells. The four major types of PV cells in order of highest to lowest performance and cost are single crystal, polycrystalline, thin film, and amorphous silicon. Photovoltaics are almost maintenance-free and have a relatively long life span (approximately 20 to 25 years). The photoelectric conversion process produces no pollution and can make use of free solar energy.

There are two PV systems: stand-alone and utility grid-interface. Stand-alone systems do not use electric utility power and are appropriate for remote locations. This system requires batteries and/or a fuel generator during times of insufficient solar radiation. The utility grid-interface system uses power supplied from the utility grid system when needed.

PV arrays must be placed where they will receive the most sunlight. At the latitude of Fort Hood, a 46-degree slope to the panels with a south orientation is best. The 46-degree slope helps offset the shorter winter day by bringing the panels closer to perpendicular to the lower winter sun. Collectors should have an unobstructed view of the sun path from at least 9am to 3pm throughout the year.

Photo: Subhendu Guha – Uni Solar, ©DOE/NREL.

PV arrays can be incorporated as shading devices for parking areas (as shown), pedestrian walkways, or outdoor gathering spaces.

Like active solar collectors, PV arrays may be mounted directly on the building or on nearby racks. When mounted either way, PV arrays must be placed where they will receive the most sunlight. At Fort Hood, a 46-degree (latitude plus 15 degrees) slope to the panels with a south orientation is best. Building-integrated PV modules are available as roofing tiles, shingles, standing seam metal roofing, spandrel panels, or as partially transparent shading elements. PV modules also are available for use as part of the building facade. They provide the same architectural appearance as tinted glass and can be tailor-made for size and shape, and can be configured as a simple facade plate or as a multifunctional element for cold or warm facades.

PV modules can also operate as sunshading devices or as windows within the outer skin of the building for a doubly effective reduction in cooling and electricity loads. The PV cell itself can be so thin that it is possible to see through it; a cell can provide a 20 to 50% filtered vision to the exterior or the cells. Alternatively, the laminate can be spaced so that partial lighting filters through the PV element and illuminates the room.

8.14.5.3 Wind Energy

In addition to solar, another form of renewable energy appropriate for Fort Hood is wind. Wind turbines can be used as stand-alone applications, or they can be connected to the utility power grid or even combined with a PV system for greater reliability. There are home systems, hybrid systems (use with other technologies like photovoltaic panels, batteries, and diesel generators), and water pumping systems to name a few. Central Texas where Fort Hood is located has wind resources that are appropriate for small-scale turbines.

Photo: Warren Gretz, ©DOE/NREL.

A small stand-alone hybrid photovoltaic/
wind system supplies all the power to this remote test building.

8.14.6 Distributed Energy Resources

Distributed energy resources (DER) are small-scale power generation sources located close to where electricity is used (e.g., a home or business) that provide an alternative to or an enhancement of the traditional electric power grid. Because they offer the potential for lower cost, higher service reliability, high-power quality, increased energy efficiency, and energy independence they should be considered for use at Fort Hood. DER also involves power electronic interfaces, as well as communications and control devices for efficient dispatch and operation of single generating units, multiple system packages, and aggregated blocks of power.

The primary fuel for many distributed generation systems is natural gas, but hydrogen may well play an important role in the future. Renewable energy technologies can also be considered.

Primary applications for DER include:

- ***Premium power.*** Reduced frequency variations, voltage transients, surges, dips, or other disruptions.
- ***Back-up power.*** Used in the event of an outage, as a back-up to the electric grid.
- ***Peak shaving.*** The use of DER during times when electric use and demand charges are high.
- ***Low-cost energy.*** The use of DER as base load or primary power that is less expensive to produce locally than it is to purchase from the electric utility.
- ***Combined heat and power (cogeneration).*** Increases the efficiency of onsite power.

Photo: Dennis Jones, ©DOE/NREL.

Hospitals and industrial facilities are excellent candidates for CHP technology.

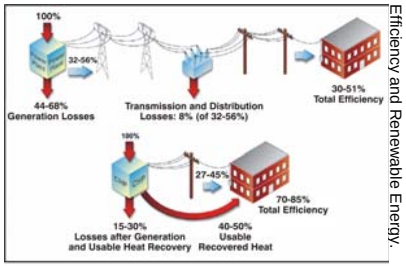


Photo: DOE, Office of Energy Efficiency and Renewable Energy.

CHP systems recover usable heat and avoid transmission and distribution losses to offer potential total efficiencies of 70-85%.

Microturbines: Small combustion turbines approximately the size of a refrigerator with outputs of 25 kilowatts (kW) to 500 kW comprised of a compressor, combustor, turbine, alternator, recuperator (a device that captures waste heat to improve the efficiency of the compressor stage), and generator. Microturbines produce both heat and electricity on a relatively small scale. They can utilize a variety of fuels and be used for resource recovery and landfill gas applications.

Combined heat and power (CHP), or cogeneration, is a commercially available and feasible DER option that offers efficiency and environmental benefits. CHP systems provide thermal energy for buildings or processes while at the same time generating electricity. The most common building applications use a prime mover (gas turbine or engine) coupled with a generator to produce electricity and capture the waste heat for process steam and space heating, or boiler steam passes through a turbine to generate electricity in addition to serving other thermal applications.

Typically, CHP systems tend to be large (greater than 500 kilowatts) and rely on proven equipment. The performance and reliability of these systems has improved steadily over the years, while operation and maintenance costs and emissions have fallen. As smaller gas turbines and fuel cell technology advance, the opportunities increase for smaller CHP applications.

8.14.7 Electrical, Communications, and Cable

All Fort Hood building distribution systems must be designed for adaptive reuse of the building resulting from expansion, renovation, or reuse for a different purpose.

8.14.7.1 Electrical (Interior)

Electrical power supply in the United States is available in a number of configurations, the most common of which are 120/240-volt single-phase three-wire, 120/208-volt three-phase four-wire, and 277/480-volt three-phase four-wire. Design standards for interior electrical systems are found in UFC 3-520-01, *Interior Electrical Systems*. Compliance with this UFC is mandatory for the design of interior electrical systems. This UFC:

- Establishes criteria for the design of interior electrical systems;
- Establishes system-level design criteria;
- Establishes facility-level criteria for interior electrical systems; and
- Provides a starting point for determining the applicable design criteria for a facility.

In addition, for interior electrical work:

- Provide a 15% space/spare for electrical panels. The panels always have circuits added during and after construction;

- Investigate the need for parallel conductors. If parallel conductors are used from the main switchgear or switchboard to distribution panel boards or from the distribution panel boards to branch circuit panels, provide design guidance to assure that the panel board gutter space is large enough to handle the conductors;

- Provide only copper conductors for building interiors. Do not use aluminum conductors;

- Provide a safety disconnect at all motor driven equipment. The safety disconnect will contain a starter and lockable disconnect as required by code. Mount the starter 4 feet above floor level for ease of maintenance;

- Provide an equipment grounding conductor in all raceways. Do not use the conduit as the equipment grounding conductor;

- Indicate on contract drawings the location of equipment grounding and grounded electrode conductor schematics. Show bonding jumpers between the structural steel, copper water supply and ground rod;

- Do not provide more than 3 circuits per conduit; and

- Use circuit breakers made specifically for high intensity discharge lighting (HID type);

For additional information related to interior wiring/ electrical design work requirements, contact the DPW.

8.14.7.2 Communications

Communications systems handle the transport of telephone and data networks (e.g., video, multi-media, teleconferencing, data transfer, facsimile transmission, and voice conversation). Fort Hood-specific design for telecommunication systems can be found in *Information Infrastructure Installation Guidelines, Fort Hood, 2006* prepared by the Fort Hood Directorate of Information Management. This guideline is to be used in conjunction with standard design criteria for interior wiring of communications and information system found in the *Installation Information Infrastructure Architecture (I3A) Design and Implementation Guide*. In the event of a conflict between these two documents, Fort Hood's *Information Infrastructure Installation Guidelines* supersedes. These guides should be used as the basis for designing both the premises distribution system (inside plant) and the

outside plant cable distribution system for all new construction and renovation projects. *The Installation Information Infrastructure Architecture (I3A) Design and Implementation Guide* is Appendix A of U.S. Army Corps of Engineers Engineering Technical Letter (ETL) 1110-3-502, Telephone and Network Distribution System Design and Implementation Guide. For a copy of the guide, contact the USACE.

Telephone System, Inside Plant

All inside telephone wiring is to be EIA/TIA 568-A, cat 5e. Modular Jacks are to be category 5, type RJ45. Pin/pair designation is to be T568B per ANSI/TIA/EIA-568-A.

Telephone System, Outside Plant Requirements

Standard commercial practices for grounding and bonding should be used. Cables should be racked in the manholes and spliced to government cables. Use stainless steel splice cases and splices will not be buried.

For work being conducted by a contractor, they will install all conduit, manholes, and cables and will make all splices to existing government systems for LAN, telephone, SIIDS and cable TV necessary for the building. Contact DOIM at (254) 287-8912 for more information.

Local Area Network (LAN) Signal distribution System Requirements

Inside LAN cable is category 5, unshielded, twisted, 4 pair. LAN jacks should be category 5, RJ45. At the backboard or closet, LAN cable should be terminated on a category 5, RJ45 patch panel. Maximum distance for cable runs are 100 meters. Runs longer than 100 meters will require an intermediate distribution point with electronics and fiber connection to the main building hub. EIA/TIA-568 Commercial Building Telecommunications Wiring Standard should be used.

Fiber Optic Data Transmission System Requirements

Outside cable is a minimum of 12-strand single mode fiber optic cable. A building hub, with sufficient ports to support the building occupants must be installed. Cable must comply with industry standards for outside fiber optic cable, such as EIA and Bellcore. Fiber is terminated in a contractor supplied ST patch panel using ST connectors. The cable is either spliced to existing government cable or extended to reach an existing government facility. At the facility, the fiber will be installed and terminated in an

ST patch panel. Contractor may have to provide additional electronics in the government facility to support the new building.

Coaxial Cable Data Transmission Media Requirements

Cable is RG6. Terminate at jack on standard TV outlet. Separate backboard from LAN and telephone. Outside cable will be installed to the nearest government cable and spliced. The length of the run determines size of cable. Amplifiers may be required to support the building.

For additional information related to the above communication systems, contact DPW.

8.14.7.3 Distribution

Distribution of electrical and electronic systems through a building is generally accomplished through branched distribution. A central chase or trunk will run the length or height of the facility, and then horizontal distribution systems will run from a central connection closet to the end user. This distribution may be overhead or underfoot; in many instances it is a combination of the two.

For more information on electrical distribution systems see Section 11.6 Utilities.

8.14.7.4 Post Construction Distribution (Cables and Wiring)

The proposed method of concealment for post-construction wiring (television, phone, electric, security, etc.), cable placement, or other similar types of distribution lines must be reviewed and approved of by the Chief of Master Planning, DPW. All cables and wiring where visually exposed, must be placed within wire mold or other approved concealment methods, (built-in chase), that are compatible and enhance the appearance of the facility.

8.14.7.5 Harmonic Mitigating Transformers

Harmonic mitigating transformers (HMTs) are used to rid facilities of the power quality problems associated with harmonic currents. Harmonics are imposed on distribution systems by adjustable speed drives; electronically ballasted lighting; and the power supplies of every computer, copier, and fax machine, and much of the telecommunications equipment used in modern offices. The widespread and growing adoption of these technologies has greatly increased the flow of harmonic currents on facility distribution systems and has given rise to a host of related problems, including overheated transformers, motors, and neutral wires; nuisance breaker trips; voltage distortion, which can cause

sensitive electronic equipment to malfunction or fail; and elevated neutral-to-ground voltage, which can cause local area networks to malfunction. HMTs have the ability to attenuate harmonic currents and thus alleviate these types of power quality problems. In addition, by canceling certain harmonic currents, HMTs can reduce the energy losses that harmonics would otherwise cause in conventional transformers. Given the right conditions, these energy savings can offset the premium price for HMTs (which can be as much as 200 percent) and yield an attractive payback period. Use harmonic mitigation transformers that meet the EPA Energy Star guidelines.

8.14.7.6 Transient Voltage Surge Suppression

Fort Hood requires the use of Transient Voltage Surge Suppression (TVSS) technologies to protect microprocessor operations from damage due to switching surges or surges associated with events like power outages. Surges can cause data upset, temporary malfunctions, or system glitches that result in lost production, data, time, and money. TVSS devices can be installed individually for basic protection or they can be installed in the network.

8.14.7.7 Power Factor

Fort Hood is accessed a power factor charge on its monthly electric utility bill when the overall power factor for the electric distribution system is less than 0.95. Currently, power factor charges are costing Fort Hood about one-half million dollars a year. Improved power factors reduce the amount of power (kW) that the utility company has to generate and the power factor charge is an incentive for the utility company's customers to improve and maintain good power factor on their systems. In an effort to improve and maintain a good power factor on its system, Fort Hood requires that for all electrical equipment with a power factor rating, that all equipment selected for use in facilities shall have a power factor rating of 0.95 or better. In cases where categories or types of equipment are manufactured with power factor ratings less than 0.95, the equipment with the best available power factor that will satisfy requirement will be selected. Ways shall be considered to improve power factor rating for equipment that has a power factor rating less than 0.95. Power factor improvement must be considered part of sustainable design and during life-cycle cost trade-offs.

8.14.8 Fire Safety: Including Permits, Alarm and Suppression Systems, and Department Access

Permit

A Hot Work Permit is required for any operation involving open flames and producing heat and/or sparks. Examples include, welding, burning, brazing, touch cutting soldering, grinding, etc. For additional information related to Hot Work permits, contact 254-288-5820.

Alarm and Suppression Systems

The following defines the fire alarm and suppression system required for installation in all new construction, renovation, modernization, or change of occupancy Compliance shall be with UFC 3-600-01, Design: Fire Protection Engineering for Facilities. Any questions related to alarm and suppression systems should be directed to: 254-288-5820.

- Fire Alarm Systems:
  - Shall be Class A systems;
  - Shall be keyed alike with CAT-15 keys;
  - All pull stations shall be keyed alike with CAT-15 keys and reset. Break glass or rods, or special tools shall not be required to reset;
  - MONACO BTXF Transmitters shall be used;
  - Knox boxes shall be installed, direct questions to 254-288-5820;
  - Fire alarm systems shall be installed in accordance with the current National Fire Protect Association (NFPA) 72 and the manufacturer's instructions;
  - Combination smoke/heat detectors shall be used on all barrack or sleeping facilities; and
  - All fire alarm submittals shall be reviewed by the fort hood fire prevention office before installation.

- For additional information related to fire suppression system construction requirements, contact the DPW.

- Sprinklers:
  - All wet pipe sprinkler systems shall be installed in accordance with the current National Fire Protection Association's (NFPA) NFPA 13, *Installation of Sprinkler Systems*;
  - All dry pipe sprinkler systems shall be installed in accordance with the current NFPA 13 and shall have floor mounted compressor; and
  - Sprinkler system submittals shall be reviewed by the Fort Hood Fire Prevention Office before installation.
  - For additional information related to sprinkler system construction requirements, contact the DPW.
- Kitchen fire suppression systems:
  - All suppression systems shall be installed in accordance with the current NFPA 17, *Standard for Dry Chemical Extinguishing Systems*, and current NFPA 17A, *Standard for Wet Chemical Extinguishing Systems*.

Ensure that each building has a sign with the building number on it and each is equipped with proper fire extinguishers. DPW, DES-Fire, and Emergency Services will no longer provide fire extinguishers.

Fire Department Access

The design for fire department access to structures must comply with the most current UFC 3-600-01 and NFPA 18. Access questions should be directed to 254-288-5820.

8.14.9 Door Hardware, Locks, and Locking Devices

Door Hardware

All door hardware on Fort Hood shall be lever type in compliance with the American Disability Act (ADA), ADA Accessibility Guidelines (ADAAG), and Unified Federal Accessibility Standards (UFAS).

Programmable Electronic Key Card Access Systems

The implementation guidance for programmable electronic key card access systems policy memorandum was issued 14 December 2004. The basic memorandum requires the use of electronic, programmable electronic key card access systems for all new construction and major building renovations. See Memorandum for Record, Subject: The Army Standards for Electronic Key Card Access for all Facilities.

Beginning in FY07, electronic key card access systems must be included in projects for facility types Unaccompanied Enlisted Personnel Housing, Transient Lodging, Officers Quarters, Operational Readiness Training Complexes, Battalion/Brigade Headquarters, Company Operations Facilities, Tactical Equipment Maintenance Facilities, and Administrative Buildings.

Electronic key card access systems will be treated as real property and are subject to normal work classification regulations. Access systems will be funded using MILCON or operation and maintenance construction or repair appropriations. Once technical implementation guidance is developed and published, all proposed FY06 and Congressional add projects that are less than 35% designed will be evaluated on a case-by-case basis to determine if electronic key card access systems should be incorporated.

Each Army installation will develop a master plan for the Electronic Key Card Access system. The master plan should specify that all buildings will use equipment from a single manufacturer so that there is consistency, compatibility, and sustainability across installed Electronic Key Card Access equipment. Each installation will be responsible for obtaining the appropriate sole source justification for their installation in coordination with the IMA region.

In accordance with the requirements of a master plan for electronic key card access, Fort Hood requires the use of the Saflok MT Lock with Key Override (System 6000) with lever handles for all barracks. In addition, Fort Hood requires all keys to be stamped with the door number, **not** the room number.

All Locksets shall have levers (for compliance with ADAAG, and UFAS) with a Stainless Steel finish and Card Lock. The contractor shall provide:

- One handheld lock encoder;

- One key-making device, and one four-hour training class;
- Six extra MT Locksets as spares;
- Exterior locks for all doors;
- One insertion encoder and all necessary software;
- A two-year warranty on the system and all components and locksets;
- 2,000 2-kilobyte memory cards (not magstrips); and
- 200 64-kilobyte memory cards that are the color red.

A Saflok representative shall install the system, program all locksets (960), and make and label all keys. The Saflok representative will need to provide all necessary equipment to make this a complete turnkey project. The programmed cards should be ready for room occupancy.

The Saflok Representative will be responsible for all of the following:

- Verify all rooms and room numbers in barracks;
- Submit to the DPW a floor plan that identifies all room numbers;
- Send list of verified room numbers to Saflok to build the database for barracks. Once the database is complete, keys and locks can be programmed;
- Program each lock;
- Program each key in the black encoder;
- Label each envelope with room number and building number (two keys for each room: an A and a B key) to contain each key. Envelope should be the kind that holds credit cards.
- Label each key with room number and corresponding room letter;
- Turn in each programmed key in their labeled envelope and have them separated by building number and in numerical order;

- Check that each key works for the room, try the master key in every lock, check and replace any dead or low batteries (takes about 1.0 hour per 40 rooms);
- Correct any non-working locks;
- After keys are finished, turn in the keys in numerical order and in envelopes; and
- Turn in the final database to DPW so the database can be uploaded on the DOIM SERVER.

In keeping with the Transient Lodging Standards, spaces for access by DPW personnel may retain key systems until a project for full conversion of all DPW access can be executed. If a new building is being built on an installation that already has electronic key card access equipment on existing buildings, the requirement for a single-type or compatible equipment for the whole installation serving both existing and new facilities should be implemented.

8.14.10 Corrosion Prevention and Control

Corrosion costs the Department of Defense (DoD) an estimated $10-$20 billion annually. In an attempt to minimize these cost, congress enacted 10 U.S.C. 2228, which emphasizes DoD management and technical awareness of corrosion prevention and control. Corrosion is a long-term issue that usually affects system or facility operation some time after procurement; but the best time to effectively combat the effects of corrosion is early in the system or facility procurement cycle.

Corrosion can have significant impact on operational readiness and safety (both by itself and in conjunction with other damage phenomena), and its interaction with these factors must be considered during conceptual design phase. The effects of corrosion increase with system or facility age, which amplifies the need to consider corrosion prevention as a primary design parameter. As a consequence, original designs should include the best materials and manufacturing processes.

To ensure an effective response to prevention or a dramatic reduction of corrosion and its effects the standard DoD corrosion control philosophy and methodology shall be used. The primary source of DoD philosophy and methodology are in its Corrosion Prevention and Control Planning Guidebook, Spiral Number 2, July 2004. This guidebook shall be used as the primary source for corrosion prevention and control programs and projects. Guidebook and a wealth of other information about corrosion are at the DoD corrosion exchange website, http:/www.dodcorrosionexchange.org/.

As noted in Section 1.10 corrosion prevention control and mitigation must be considered during life-cycle cost tradeoffs.

8.14.11 Building Metering

Fort Hood is committed to reducing energy costs and protecting the environment through the implementation of sustainable design and development principles. Therefore, to measure building system performance Fort Hood requires utilities (gas, water, electric) to be metered to the building with an electrical monitoring connection to a meter interface unit.

8.14.12 References and Resources Related to Building Systems

8.14.12.1 HVAC Systems

- American Conference of Governmental Industrial Hygienists (ACGIH), 2001, *Industrial Ventilation: A Manual of Recommended Practice*, 24th Edition, Committee on Industrial Ventilation.
- AR 11-27, *Army Energy Program*, Chapters 3 through 6, http://www.army.mil/usapa/epubs/pdf/r11_27.pdf
- ASHRAE Standard 55-2004, *Thermal Environmental Conditions for Human Occupancy*
- ASHRAE Standard 62.1-2004, *Ventilation for Acceptable Indoor Air Quality*
- ASHRAE Standard 90.1-2001, *Energy Standard for Buildings Except Low-Rise Residential Buildings*.
- Associated Air Balance Council (AABC), 2002, *National Standards for Total System Balance*, 6th edition, AABC, Washington, D.C.
- National Environmental Balancing Bureau (NEBB), *Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems*, http://www.nebb.org/
- Office of Geothermal Technologies, *Geothermal Heat Pumps Score High Marks in Schools*, http://www.eere.energy.gov/geothermal/pdfs/26161a.pdf

- Sandia National Labs, *Monitored Performance of Residential Geothermal Heat Pumps in Central Texas and Southern Michigan*, http://www.stormingmedia.us/73/7323/A732333.html
- U.S. Department of Energy, *Building Energy Software Tools Directory*, http://www.eere.energy.gov/buildings/tools_directory/
- U.S. Department of Energy, Federal Energy Management Program, http://www.eere.energy.gov/femp/
- U.S. Department of Energy, Federal Energy Management Program, *Geothermal Heat Pumps Deliver Big Savings for Federal Facilities*, Technology Focus, DOE/EE-0291, http://www.eere.energy.gov/femp/pdfs/ghptf.pdf
- UFC 3-400-01, *Energy Conservation*, http://www.hnd.usace.army.mil/techinfo/ufc/081602_UFC3-400-01.pdf
- UFC 3-410-01FA, *Design: Heating, Ventilating, and Air Conditioning*, http://www.hnd.usace.army.mil/techinfo/UFC/UFC3-410-01FA/UFC3-410-01FA.pdf
- UFC 3-410-04N, *Design: Industrial Ventilation*, http://www.wbdg.org/ccb/DOD/UFC/3_410_04n.pdf
- UFGS-13801, *Utility Monitoring and Control Systems*, http://www.hnd.usace.army.mil/techinfo/UFC/UFC3-401-01FA/UFC3-401-01FA.pdf
- UFGS-15990A, *Testing, Adjusting, and Balancing of HVAC Systems*, http://www.wbdg.org/ccb/DOD/UFGS/UF15990A.pdf
- UFGS-15951, *Direct Digital Controls for HVAC and Other Local Building Systems*, http://www.wbdg.org/ccb/DOD/UFGS/UF15951.pdf
- UFGS-15995A, *Commissioning of HVAC Systems*, http://www.wbdg.org/ccb/DOD/UFGS/UF15995A.pdf

- USACE, Engineering and Construction Bulletin No. 2004-11, *Utility Monitoring & Control Systems (UMCS) and Direct Digital Control (DDC) Criteria Update*, http://www.hnd.usace.army.mil/techinfo/ECB/ECB%202004-11.pdf

8.14.12.2 Interior Lighting and Controls

- TI 811-16, *Lighting Design*, http://www.hnd.usace.army.mil/techinfo/ti/811-16.pdf
- U.S. Army Corps of Engineers, DG 1110-3-122, *Design Guide for Interiors*, Chapter 5, http://www.usace.army.mil/inet/usace-docs/design-guides/dg1110-3-122/entire.pdf
- Air Force Interior Design Guides, Chapter 10, "Light and Lighting," http://www.afcee.brooks.af.mil/dc/dcd/interior/indespubs/light95.pdf
- UFC 3-520-01, Interior Electrical Systems, Appendix F, http://www.hnd.usace.army.mil/techinfo/ufc/ufc_3-520-01.pdf
- TM 5-683, *Electrical Interior Facilities*, Chapter 9, information on lighting maintenance, types, and lamp trouble-shooting, http://www.usace.army.mil/inet/usace-docs/armytm/tm5-683/c-9.pdf

8.14.12.3 Water-using Fixtures and Mechanical Systems

- Executive Order 13123, *Greening the Government through Efficient Energy Management*, http://ceq.eh.doe.gov/nepa/regs/eos/eo13123.html
- 2003 International Plumbing Code
- Energy Star, http://www.energystar.gov/index.cfm?fuseaction=find_a_product.

8.14.12.4 Water Reuse Systems and Applications

- Executive Order 13123, *Greening the Government through Efficient Energy Management*, http://ceq.eh.doe.gov/nepa/regs/eos/eo13123.html
- *Texas Guide to Rainwater Harvesting*, http://www.twdb.state.tx.us/publications/reports/RainHarv.pdf

- *City of Tucson Water Harvesting Manual*, http://dot.ci.tucson.az.us/stormwater/downloads/2006WaterHarvesting.pdf
- Texas Administrative Code (TAC), Chapter 210, *Use of Reclaimed Water*, http://info.sos.state.tx.us/pls/pub/readtac$ext.ViewTAC?tac_view=4&ti=30&pt=1&ch=210
- TAC, Chapter 285, *Onsite Sewage Facilities*, http://info.sos.state.tx.us/pls/pub/readtac$ext.ViewTAC?tac_view=4&ti=30&pt=1&ch=285

8.14.12.5 Renewable Energy Systems

- UFC 3-440-01, *Design: Active Solar Preheat Systems*, http://www.hnd.usace.army.mil/techinfo/ufc/ufc_3-440-01.pdf
- UFC 3-440-03N, *Design: Passive Solar Buildings*, http://www.wbdg.org/ccb/DOD/UFC/3_440_03n.pdf
- UFC 3-440-04N, *Design: Solar Heating of Buildings and Domestic Hot Water*, http://www.wbdg.org/ccb/DOD/UFC/3_440_04n.pdf
- UFC 3-440-06N, *Design: Cooling Buildings with Natural Ventilation*, http://www.wbdg.org/ccb/DOD/UFC/3_440_06n.pdf
- UFC 3-520-01, *Interior Electrical Systems*, http://www.hnd.usace.army.mil/techinfo/ufc/ufc_3-520-01.pdf
- *USAF Passive Solar Handbook*, http://www.wbdg.org/ccb/AF/AFH/pshbk_v3.pdf
- *The IESNA Handbook* (from the Illuminating Engineering Society of North America)
- Texas Solar Energy Society, http://www.txses.org/

8.14.12.6 Distributed Energy Resources

- U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Distributed Energy Program, http://www.eere.energy.gov/de/

- Federal Energy Management Program, *Using Distributed Energy Resources, A How-To Guide for Federal Facility Managers*, http://www.nrel.gov/docs/fy02osti/31570.pdf

8.14.12.7 Electrical, Communications, and Cable

- Fort Hood's *Technical Supplement to the Design Guide for Fort Hood April 2001* can be obtained by contacting the Chief of Master Planning

- UFC 3-520-01, *Interior Electrical Systems*, http://www.hnd.usace.army.mil/techinfo/ufc/ufc_3-520-01.pdf

- *The Installation Information Infrastructure Architecture (I3A) Design and Implementation Guide* is Appendix A of U.S. Army Corps of Engineers engineering technical letter (ETL) 1110-3-502, Telephone and Network Distribution System Design and Implementation Guide. For a copy of the guide, contact the USACE.

8.14.12.8 Fire Alarm and Suppressant Systems

- UFC 3-600-01, *Design: Fire Protection Engineering for Facilities*, http://www.wbdg.org/ccb/DOD/UFC/3_600_01.pdf

- NFPA 13, *Installation of Sprinkler Systems*

- NFPA 17, *Standard for Dry Chemical Extinguishing Systems*

- NFPA 17A, *Standard for Wet Chemical Extinguishing Systems*.

8.15 PEST MANAGEMENT BUILDING DESIGN AND LAYOUT

All pest management activities at Fort Hood must be conducted in accordance with the Installation Pest Management Plan (IPMP). The plan stresses the principles of integrated pest management (IPM). These IPM principles employ the judicious use of both chemical and non-chemical control techniques to achieve effective pest management with minimal environmental contamination. At Fort Hood, non-chemical control efforts will be used to the maximum extent possible before pesticides are used.

All new and renovation construction projects at Fort Hood will be reviewed for pest prevention and control measures. The Installation Pest Management Coordinator (IPMC; phone number 254-288-5030) and staff from the Preventive Medicine Service, Medical Department Activity will review design documents for new construction projects to ensure pre-construction termite treatment is included in the project specifications. They will also conduct a pest-prevention evaluation in the constructed facility prior to project completion to ensure that pest entry points and potential harborage have been eliminated. For example, past experience at Fort Hood has found that proper post-excavation site grading eliminates ponding of water on-site, which, in turn, reduces mosquito population booms. Also, it has been found that careful inspection of facilities during and after construction can prevent many cases of bird nesting and bat infestation. All post-occupancy infestations should be reported to the IPMC for the implementation of proper treatment and control measures.

Note: New construction termite treatments: Only termiticides that are approved for use by the DPW Environmental Division IPMC will be used. See IPMP Appendix E Termite Preconstruction Treatment for more information.

As applicable to the project, the following pest control measures for all new and renovation construction projects are required.

Building Exteriors

- All building exterior cracks and crevices shall be properly sealed.
- All caulking or sealing material shall be rodent impermeable.
- All expansion joints shall be sealed to prevent entrance of rodents, bats, and birds.

- All cracks and openings around outdoor lights should be thoroughly sealed to prevent insect entrance (especially crickets) into the building.
- Cover all vents greater than 0.25-inch with durable mesh, with vents in basement areas being especially durable and rodent-proof. Under-building vents that contain water drains should be covered with screen mesh to prevent mosquito entry.
- Building exteriors should not contain ledges, crevices, or other structures that allow birds to roosts or nest.
- All exterior doors should seal properly and have bottom door sweeps properly installed.
- All bay type doors should have top and bottom sweeps installed.

Outdoor Lighting

- Consistent with Section 11.5, consider low-pressure sodium vapor lamps and yellow incandescent "bug lights;" these are less attractive to crickets and other insects than standard incandescent, fluorescent, mercury vapor, or halogen lights.
- Consistent with Section 11.5, when flood lights (high-intensity lighting) are necessary for a facility, indirect lighting is preferred. The majority of the insects will migrate to the light instead of congregating on the building.
- Consistent with Section 11.5, light source activation can minimize the congregation of insects in proximity to buildings. Certain types of facilities will benefit by having select inside and outside lights operated in the evening by motion sensors and timers. Example: BLORA public restrooms.

Building Interior

- Insure all HVAC and other pipes prone to sweating are properly insulated. (Ongoing condensation provides breeding sites for drain flies and other pests).
- The insulation in the walls and ceilings of open bays should be properly sealed and impermeable to nesting and roosting birds and roosting bats.

8.16 RECYCLING ACTIVITIES

Fort Hood has an active recycling program meant to facilitate the reduction of waste generated by building occupants and that is hauled to and disposed of in landfills. Solid waste generation varies by building type. Table 8-16 shows typical standards for estimating solid waste generation by building type. Fort Hood tracks its solid waste and recycling effort in a variety of ways. Data collected show approximately 41% of the administrative/institution waste stream is of recyclable content. Similarly, approximately 43% of the industrial waste steam is of recyclable content. The composition of recyclable material is show in Table 8-17.

As directed by III Corps and Fort Hood Regulation 420-6 Recycle Program, all persons working or residing on Fort Hood are required to divert recyclable and reusable materials from the solid waste stream to the maximum extent practical. Organizations must ensure that systems are in place to make recycling as convenient as possible and that personnel are recycling to the maximum extent possible. As with all other efforts to protect the environment, recycling is part of the Fort Hood mission. All levels of the organization will strive to make recycling a habit rather than another task to be performed. Both interior and exterior recycling collection points are considered appropriate for Fort Hood.

Past experience at Fort Hood has shown that it is essential that building designs incorporate sufficient room for recycling containers within the building and the outside areas. Otherwise, the staff occupying the building is burdened with the requirement to bring recycle material to the Fort Hood recycling facility.

To help meet Fort Hood's 25-Year Sustainable Goal to minimize waste, in the planning/design phase of all new buildings, Fort Hood requires that the designer designate collection and storage areas for recyclables including office paper, newspaper, cardboard, glass, metals, and plastics. The designer will ensure that the collection and storage space is sized to accommodate all building occupants and is convenient to use.

Table 8-16
Typical Solid Waste Generation by Type of Building

Building Type	Amount of Solid Waste
Warehouses	1.5 lbs/100 SF/day
Office Buildings	1 lb/100 SF/day
Department Stores	3 lbs/100 SF/day
Supermarkets	7 lbs/100 SF/day
Restaurants	2 lbs/100 SF/day
Drugstores	3 lbs/100 SF/day
Cafeterias	0.5 to 0.75 lbs/meal
Clubs	1.5 lbs/meal
Hotels	2 lbs/room/day & 2 lbs/meal
Schools	6 lbs/room & 0.25 lbs/student/day
Hospitals	20 lbs/bed/day & 2 lbs/meal

Key:
lbs = pounds.
SF = square feet.
Source: USGBC LEED Reference Guide, Version 2.1

Photo: Sheila Hayter, ©DOE/NREL.

Identify facility recycling needs during the design phase to ensure collection points are convenient and accessible to all building occupants.

Table 8-17 Contents of Recyclable Waste, Fort Hood	
Administrative / Institution Content of Recyclable Waste	**Industrial Content of Recyclable Waste**
Cardboard – 15%	Cardboard – 56%
Mixed Paper – 30%	Mixed Paper – 12%
Aluminum Cans 1%	Aluminum Cans – 1%
Yard Waste - 18%	Mixed Metals – 10%
Newspaper – 4%	Wood – 11%
Food Scrapes – 32%	Mixed Plastics – 10%

Table 8-18 Sizing Guidelines for Recycling Areas	
Commercial Building Size (square feet)	**Minimum Recycling Area (square feet)**
0 to 5,000	82
5,001 to 15,000	125
15,001 to 50,000	175
50,001 to 100,000	225
100,001 to 200,000	275
200,001 or more	500

Source: USGBC LEED Reference Guide, Version 2.1.

The central collection and storage area for the building must have easy access for collection vehicles.

Fort Hood prefers interior collection points because of the ease of access for the building occupant. Ease of access is expected to result in a greater amount of recycling; however, it is important to address possible indoor environmental quality impacts on building occupants due to recycling activities. Activities that can create odors, noise, and air contaminants should be isolated or performed during non-occupant hours to maintain optimal IAQ.

All exterior collection points must be fully screened from public view with a wall(s)/fence(s) constructed of sustainable material and compatible with the architectural style of the building/visual zone. Walls or fences used to screen exterior collection points shall be visually enhanced through the planting of landscape material. Exterior collection points must meet force protection requirements (see Section 12), including the setback distance from the building. It is believed that this setback distance may discourage recycling.

General guidelines for sizing recycling areas are provided in Table 8-18.

Making recycling decisions early in the design process is the best way to encourage participation in the Fort Hood Recycle Program and promote recycling activities. Proceeds from the sale of recyclable materials in excess of those required to run the recycling program can be used for Morale, Welfare, and Recreation projects to improve the overall quality of life for the soldiers and their families at Fort Hood.

8.17 KEY FACILITY TYPES STANDARDIZATION

The Assistant Chief of Staff for Installation Management (ACSIM) establishes Army facility standards and approves deviations from the standards.

8.17.1 Residential Communities Initiative (RCI)

The intent of the Residential Communities Initiative (RCI) is to improve the housing for military families by providing quality housing, built in attractive neighborhoods. To ensure a uniform level of quality throughout the RCI, Headquarters, Department of the Army has developed the "Standards for Housing at RCI Projects - Update # 2." These standards apply to the construction, renovation, and condition of privatized housing. Compliance with these standards is mandatory unless the Department of the Army RCI office approves a waiver in writing. These standards apply to RCI projects with Community Development and Management Plan (CDMP) collaboration contracts awarded after January 1, 2005, and are not retroactive to previous projects.

RCI projects will apply installation practices and policies to RCI projects. Paragraph 3(b) of the "Standards for Housing at RCI Projects - Update # 2" reads: "Many installations have published guidelines and construction standards (e.g., Installation Design Guide) that may exceed or differ substantially from local codes and standards. It is DA RCI's intention that installation practices and polices apply to RCI projects unless waived by appropriate installation authorities. If an installation guideline or standard appears unreasonable for an RCI project and a consensus solution cannot be reached at the installation level, DA RCI may be consulted in resolving the conflicting standards."

8.17.2 Department of the Army Facilities Standardization Program

Under the Department of the Army (DA) Facilities Standardization Program, standard design packages are developed for facility types that are repetitively designed and constructed at Army installations. These design packages are developed to the definitive design level (10 to 15%) and, once approved, are mandatory for Army Military Construction (MILCON).

Currently, there are 31 DA standard design packages. Headquarters, U.S. Army Corps of Engineers has established eight Centers of Standardization to develop and maintain the definitive and design packages. See Appendix P, DA Facilities Standardization Program Centers of Standardization of this IDG for a list of the various centers and the facility type assigned to each center.

The Army Chapel Standard Definitive Design establishes three set chapel sizes and specifies the requirements for worship and activity areas, classrooms, and other unique features and criteria. The Facility Design Team (FDT) for Chapels issues standard designs that incorporate the mandatory Army Standard for Chapel Construction and provide the recommended layout for the most efficient configuration of all the required elements.

8.17.2.1 Unaccompanied Personnel Housing (Army Barracks Modernization Program)

The Army's Barracks Modernization Program is based on a whole community approach providing modernized private living and sleeping areas for soldiers, as well as a more functional work environment. This is being realized with the construction and renovation of barracks, associated Company Operations Facilities (COF), Battalion Headquarters (BN HQ), Brigade Headquarters (BDE HQ), and Dining Facilities (DEFAC). For a detailed discussion of the Army Barracks Modernization Program see the Army Barracks Master Plan. The Army Barracks Master Plan only includes requirements for active duty permanent party soldiers barracks.

Army Barracks Standards

The Army Barracks Modernization Program design criteria give commanders and contractors the direction to incorporate best business practices around a modular floor plan. The Army Barracks Master Plan, Appendix I, Army Barracks Standards promotes barracks with an appropriate balance between private and common areas. The Vice Chief of Staff of the Army (VCSA) specified the "New Army Barracks Construction Criteria" in his Memorandum Subject: New Barracks Construction Criteria, dated 11 July 2002 in which he strongly endorsed the new standards. The criteria were further revised in Memorandum Subject: Revised Barracks Construction Criteria, dated 1 May 2003 which makes the following four changes to the Army Barracks Standards:

- Establishes the two-bedroom/one-bath module as the standard module;
- Requires installation of a stove or cook top;
- Requires laundries in the barracks; and
- Eliminates the separate solider community building.

See the above memorandum for detailed guidance.

Furnishings

Acquisition of new furnishings is planned and accomplished in concert with the facility design and construction schedule so that delivery of the new furnishings coincides with the beneficial occupancy date (BOD).

The *U.S. Army Interior Design Manual (IDM) for Single Soldiers* provides guidance to help furniture managers prepare order packages. The manual uses standard Army furniture specifications, i.e. medium oak wood furnishings or acceptable wood/steel alternatives, construction and fabric specification, and specific information for authorized items of furniture. The manual also contains standard living/sleeping room arrangements, and Soldier Community Building (SCB) plans with color schemes. The manual includes information on waiver requirements, the procurement process, order forms, and final inspection checklist.

Construction design criteria for COFs, BBN HQ buildings, BDE buildings, and DEFAC facilities can be viewed on the web at ProjNet.

8.17.2.2 Company Operation Facility Standards

The U.S. Army Field Support Command (AFSC) approved Army Standards for Company Operations Facilities (COFs) on 20 May 2004. These standards are effective starting with FY 06MCA projects and must be applied to all construction of new COFs on all installations. The AFSC must approve any planned changes from the COFs Army Standards. The COFs Army Standards incorporate the following characteristics:

- Battalion centric design;
- Flexible design;
- Enlarged lockers;
- Increased interior space;
- Covered exterior maintenance areas;

- Enlarged arms vaults;
- Non-sensitive item secure storage;
- Consolidated showers;
- Economy of construction; and
- Proximity to unit motor pool.

The Army Facilities Standardization Sub-Committee approved the Standard Design for Company Operations Facilities on 6 July 2004; Memorandum for Record, Subject: Standard Design for Company Operations Facilities, dated 6 July 2004 (see http://www.mantech-mec.com/army_ids/Facility_DOC/COF_Design_pdf/COF_Modified_Standard_Design_05_2004.pdf).

8.17.2.3 General Instruction Building and Army Continuing Education System Standards

The AFSC has approved standards for classroom facilities, which provide for flexibility in instructional use while accommodating all instructional needs as well as providing for administrative, special function use, and support space. These standards include Standard Design Criteria defining spatial and functional requirements. All facilities shall be ADA compliant. See The Army Standard for General Instruction Building (GIB) and Army Continuing Education System (ACES) Facilities and Memorandum for Record, Subject: The Army Standard for General Instruction Building (GIB) and Army Continuing Education System (ACES) Facilities, dated 01 December 2004.

8.17.2.4 Child Development Centers

Child Development Centers (CDCs) are intended to serve two juvenile groups: ages six weeks to five years, and six to 10 years. CDC facilities for ages six weeks to five years shall conform to Appendix G, Child Development Center of TI 800-01, Design Criteria. There are seven design packages that include child capacities of 60, 99, 122, 145, 198, 244, and 303 children (see ProjNet design packages).

CDC facilities for ages six years to 10 years shall conform to Army Standards for Child Development Center Construction (for school-age children) October 2004 per Memorandum for Record, Subject: Army Standards for Child Development Centers, dated 19 October 2004. The AFSC-approved Standard

Designs for four CDC facility designs that include the following child capacities: 60-65 child capacity (Wing Addition), 105-135 child capacity, 150-180 child capacity, and 195-225 child capacity.

8.17.2.5 The Army Standard for Army Lodging

The AFSC has approved The Army Standard for Army Lodging. These standards promote economies in serving the Army traveler, but not at the expense of quality or service. The standards define the facilities and the level of service the Army traveler should expect when they travel to an Army installation. The facility standard and level of service will be consistent from installation to installation. See The Army Standard for Army Lodging and Memorandum for Record, Subject: Army Standards for Army Lodging, dated 14 December 2004.

8.17.2.6 Access Control Points

The AFSC has approved The Army Standard for Access Control Points (ACPs). The standard provides detailed criteria for the development of entrance facilities and appurtenances within, and related to, the ACP corridor, which will be understood to include the secured area between the entrance gate and the final set of vehicle barriers. Criteria shall be concerned with all aspects of Force Protection in regard to vehicular and pedestrian access to installations, safety, optimum working conditions for personnel, and the defeat of any threat to installation security. See The Army Standard for Access Control Points (ACPs) dated 14 December 2004.

8.17.2.7 Morale, Welfare, and Recreation Branded Theme Operations

The U.S. Army Community and Family Support Center (CFSC), through its Theme Operations, offers comprehensive theme packages pertaining to restaurants and entertainment centers. The packages are customized to the installation.

CFSC will conduct an assessment for market viability and will provide architectural designs and other promotional items. Information on the CFSC Branded Theme Operations including how to get a theme operation, management support, and food service support is located on the CFSC website at the U.S. Army Theme Operations home page, http://www.armymwr.org.

8.17.2.8 Range Standards

Range Standards. The Army Sustainable Range Program (SRP) proponent is HQDA Office Deputy Chief of Staff Operations, ODCSOPS/G3 (DAMO-TRS), phone number (703) 692-6410. The SRP develops and manages standard designs for Army ranges in accordance with AR 210-21 and Training Circular 25-8 Army Training Ranges. The Range Standards are available at:

- Design Manual for Remoted Target Systems (RETS) Ranges, CEHCN 1110-1-23 Manual.
- Revised Range Design/Construction Interface Standards.
- Unexploded Ordinance Considerations in the Planning, Design, and Construction of Ranges, Supplement to CEHNC 1110-1-23 Manual.

8.17.3 References and Resources Related to Key Facility Types Standardization

- AR 210-21, *Army Ranges and Training Land Program*, https://134.11.61.26/CD4/Publications/DA/AR/AR%20210-21%2019970501.pdf
- *Army Barracks Master Plan*, Appendix I, Army Barracks Standards, http://housing.army.mil/Documents/uph_mp/uphmp_appi.pdf
- *Army Barracks Master Plan*, http://housing.army.mil/uph_plan.htm
- Army Chapel Standard Definitive Design, http://www.mantech-mec.com/fme_web/IDG/pdf/Army%20Chapel%20Standard%20Definitive%20Design.pdf
- Army Standard for Chapel Construction, http://www.mantech-mec.com/fme_web/IDG/ArmyStandard-Chapelfacilities_11Feb04_.pdf
- Assistant Chief of Staff for Installation Management, Memorandum, Subject: Revised Barracks Construction Criteria, dated 1 May 2003, http://www.hqda.army.mil/acsimweb/fd/construction/docs/ACSIM-CEMPMemo1May03.pdf
- Assistant Secretary of the Army Memorandum, Subject: Sustainable Design and Development Requirements, dated 18 March 2003, http://www.mantech-mec.com/fme_web/IDG/ASAIESDDPolicy.pdf

- ProjNet, http://www.projnet.org/
- Residential Communities Initiative, http://rci.army.mil/
- Residential Communities Initiative, *Minimum Quality Standards for New and Replacement Residential Communities Initiative (RCI) Family Housing*, http://www.rci.army.mil/programinfo/RCIConstruction_Standards_IP.pdf
- Training Circular 25-8, *Training Ranges*, https://atiam.train.army.mil/soldierPortal/atia/adlsc/view/public/6851-1/TC/25-8/TOC.HTM
- U.S. Army Corps of Engineers, Centers of Standardization, http://www.usace.army.mil/civilworks/cecwe/coexpert/coshomepage.htm
- U.S. Army Corps of Engineers, *Revised Range Design/Construction Interface Standards*, http://www.hnd.usace.army.mil/rtlp/DesignManuals.aspx
- U.S. Army Corps of Engineers, *U.S. Army Interior Design Manual (IDM) for Single Soldiers*
- U.S. Army Corps of Engineers, *Unexploded Ordinance Considerations in the Planning, Design, and Construction of Ranges*, Supplement to CEHNC 1110-1-23 Manual, http://www.hnd.usace.army.mil/rtlp/UXO/UXO%20Procedures.pdf.
- U.S. Army Morale, Welfare, and Recreation, *Army Lodging Standards for Service*, *http://www.armymwr.com/corporate/docs/lodging/lodgingstandardsservice.DOC*
- U.S. Army Morale, Welfare, and Recreation, *Army Lodging Standards for Operations*, *http://www.armymwr.com/corporate/docs/lodging/lodgingstandardsoperations.DOC*
- U.S. Army Morale, Welfare, and Recreation, *Army Lodging Standards for Facilities*, *http://www.armymwr.com/corporate/docs/lodging/lodgingstandardsfacilities.DOC*
- U.S. Army Theme Operations home page, http://www.armymwr.org/home/Show_file.asp?fileID=456

- Vice Chief of Staff of the Army, Memorandum, Subject: New Barracks Construction Criteria, dated 11 July 2002, http://www.hqda.army.mil/acsimweb/fd/construction/docs/VCSAMemoEncls11July2002.pdf

8.18 PHYSICAL SECURITY REQUIREMENTS

To assure that the required physical measures are met, the planning, design, and construction efforts of all construction projects will be coordinated with the installation Provost Marshall or Physical Security Officer. (See AR 190-13, *The Army Physical Security Program*, Paragraphs 1-26. Also see Section 12, Force Protection for a more detailed discussion regarding anti-terrorism measures.)

8.19 SALE AND OUTLEASE OF ARMY ASSETS

In an effort to offset some of the impacts of constrained resources, the Army has implemented initiatives that improve cost effectiveness and efficiency of installation operations. To the extent permitted by law, funds that become available as a result of these initiatives are retained by, or returned to, garrison commanders.

The Office of the Assistant Secretary of the Army for Financial Management and Comptroller (OASA [FM&C]) has developed the *Sales and Outlease of Army Assets - Installation Guide* to assist garrison commanders in using the sales and outlease program. The guide provides an overview of major policies, procedures, and responsibilities pertaining to the following three major initiatives of the program:

- Sale of real property;
- Outlease of real property; and
- Outlease of personal property.

The guide provides hyperlinks to sale and outlease governing regulations and legal and informational references.

8.20 ARMY STANDARDS

The following cited Army Standards shall be met.

- AR 420-70, *Buildings and Structures*, http://www.hqda.army.mil/acsimweb/fd/policy/ar420-70/main/index_txt.htm
- UFC 3-520-01, *Interior Electrical Systems*, http://www.hnd.usace.army.mil/techinfo/ufc/ufc_3-520-01.pdf
- UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*, http://www.acq.osd.mil/ie/irm/irm_library/UFC4_010_01.pdf
- Americans with Disabilities Act Accessibility Guidelines (ADAAG), http://www.access-board.gov/adaag/html/adaag.htm
- Uniform Federal Accessibility Standards (UFAS), http://www.access-board.gov/ufas/ufas-html/ufas.htm
- Secretary of the Interior's Standards for the Treatment of Historic Properties, http://www.cr.nps.gov/local-law/arch_stnds_8_2.htm
- U.S. Army Corps of Engineers Engineering Technical Letter (ETL) 1110-3-502, *Telephone and Network Distribution System Design and Implementation Guide*, http://www.wbdg.org/ccb/ARMYCOE/COETEK/tl3_502.pdf. For a copy of the guide, contact the USACE.
- Standards of Seismic Safety for Existing Federally Owned and Leased Buildings, http://www.mantech-mec.com/fme_web/IDG/SeismicStandardsBuildings.pdf
- Army Barracks Master Plan, Appendix I, Army Barracks Standards, http://housing.army.mil/Documents/uph_mp/uphmp_appi.pdf
- Memorandum, Subject: Revised Barracks Construction Criteria, dated 1 May 2003, http://www.hqda.army.mil/acsimweb/fd/construction/docs/ACSIM-CEMPMemo1May03.pdf

- Quality Standards for New and Replacement Residential Communities Initiative (RCI) Family Housing, http://www.rci.army.mil/programinfo/RCIConstruction_Standards_IP.pdf
- Army Lodging Standards, http://www.armymwr.com/corporate/programs/lodgingandtravel/standards.asp
- Design Manual for Remoted Target Systems (RETS) Ranges, CEHNC 1110-1-23 Manual
- Unexploded Ordinance Considerations in the Planning, Design, and Construction of Ranges, Supplement to CEHNC 1110-1-23 Manual
- Revised Range Design/Construction Interface Standards, http://www.hnd.usace.army.mil/rtlp/UXO/UXO%20Procedures.pdf

8.21 OTHER REFERENCES AND RESOURCES

- *Air Force Interior Design Guides*, http://www.afcee.brooks.af.mil/dc/dcd/interior/intdespu.asp
- *Air Force Sustainable Facilities Guide*, http://www.afcee.brooks.af.mil/dc/dcd/arch/rfg/index.html
- AR 190-13, *The Army Physical Security Program*, http://www.usapa.army.mil/pdffiles/r190_13.pdf
- AR 200-1, *Environmental Protection and Enhancement*, http://www.usapa.army.mil/pdffiles/r200_1.pdf
- AR 200-2, *Environmental Effects of Army Actions*, http://www.usapa.army.mil/pdffiles/r200_2.pdf
- AR 200-4, *Cultural Resources Management*, http://www.usapa.army.mil/pdffiles/r200_4.pdf
- AR 405-45, *Real Property Inventory Management*, http://www.usapa.army.mil/pdffiles/r405_45.pdf
- Assistant Chief of Staff for Installation Management, Sustainable Design and Development Website, http://www.hqda.army.mil/acsimweb/fd/linksSDD.htm

- Department of Defense Interior Design website, http://tsc.wes.army.mil/ID_Resources_DoD/index.htm
- Engineering and Construction Bulletins, http://www.hnd.usace.army.mil/techinfo/ECbull.htm
- Greening Federal Facilities (May 2001), http://www.eere.energy.gov/femp/technologies/sustainable_greening.cfm#frontmatter
- III Corps and Fort Hood Regulation 420-6 Recycle Program, http://www.dpw.hood.army.mil/Files/ENV/fhreg420-6.pdf
- Office of the Assistant Secretary of the Army for Financial Management and Comptroller (OASA [FM&C]) *Sales and Outlease of Army Assets - Installation Guide*, http://www.asafm.army.mil/rabp/info/sop/sop.doc
- TM 5-683, *Electrical Interior Facilities*, http://www.usace.army.mil/inet/usace-docs/armytm/tm5-683/
- TM 5-688, *Foreign Voltage and Frequencies Guide*, http://www.usace.army.mil/inet/usace-docs/armytm/tm5-688/
- U.S Army Corps of Engineers, Engineering Research and Development Center, Construction Engineering Research Laboratory (CERL), Sustainable Design and Development Website, http://www.cecer.army.mil/sustdesign
- U.S. Army Corps of Engineers, Design Guide 1110-3-122, *Design Guide for Interiors*, http://www.usace.army.mil/inet/usace-docs/design-guides/dg1110-3-122/entire.pdf
- U.S. Department of Energy, Energy Efficiency and Renewable Energy Federal Energy Management Program 2000-2004, http://www.eere.energy.gov/femp/
- U.S. Green Building Council, Leadership in Energy and Environmental Design, *Green Building Rating System for New Construction and Major Renovations*, Version 2.1, http://www.usgbc.org/Docs/LEEDdocs/LEED_RS_v2-1.pdf

- UFC 1-200-01, *Design: General Building Requirements*, http://www.wbdg.org/ccb/DOD/UFC/ufc_1_200_01.pdf
- UFC 2-600-01, *Installation Design*, Chapter 8, http://knxas1.hsdl.nps.navy.mil/homesec/docs/dod/nps03-080504-01.pdf
- Whole Building Design Guide, http://www.wbdg.org/

9.1 INTRODUCTION

The image of the installation is greatly determined by the design and location of roadways, walkways, entrances, and parking lots. The primary roadway system and parking lots utilize considerable amounts of land and are a visually dominant element of any installation. The location of primary circulation elements is presented in Section 7, Site Planning. This section discusses the details of circulation design and impacts.

The circulation system provides a primary vantage point from which all installations are viewed. Safe and efficient vehicular movement results in better orientation and contributes to the development of a positive environment for installation personnel and visitors. The circulation component is used to assess the circulation elements of the installation and identify specific characteristics that provide visual zone and theme identity.

Roadways, pedestrian walkways and bicycle trails will be designed to provide a hierarchy of circulation design and carrying capacity. Functionally, a hierarchical network can be created that separates incompatible types of traffic. This separation of traffic promotes sustainability because it encourages non-motorized modes of travel, resulting in more efficient energy consumption.

By providing landscaped islands in parking lots you provide shade for parked vehicles, increase the amount of pervious surface and provide a safe pedestrian circulation route.

Provide roadway systems that provide for pedestrian, bikers and automobiles

Well marked pedestrian crossings provide a safer environment in high foot-traffic areas

The highway that leads to the main entrance to Fort Hood and becomes Hood Rd.

Visually, the circulation hierarchy can be reinforced through design, planting, signage, and lighting to promote a more attractive visual experience and promote a sense of orientation.

9.2 CIRCULATION OBJECTIVES

The goal for the circulation system on the installation is to establish a sustainable system that promotes aesthetic appeal, environmental preservation and energy conservation while providing safe and efficient circulation. The objectives below should be followed to achieve a sustainable circulation system:

- Provide a system of circulation that includes all forms of vehicular and pedestrian circulation.
- Provide a system that includes hierarchies of vehicular and pedestrian traffic flow.
- Adapt the circulation system to the natural conditions of the site.
- Improve the existing circulation network for expansion, safety, way finding, and appearance.
- Promote maintenance and repair of existing and proposed circulation systems.65
- Minimize site land disturbance.
- Provide a system that takes incident management into consideration.
- Promote the use of pervious pavement material.

PERVIOUS PAVEMENT

Fort Hood is committed to the use of pervious pavement within all circulation systems at the installation. Pervious pavement has applications in the development or redevelopment of roadways, parking lots and pedestrian and bikeway circulation routes. Not only does pervious pavement offer a reduction in site stormwater runoff, but by its porous nature it can help reduce the heat island effect. Pervious pavements are less able to absorb and store heat than conventional pavements. The lower density of the material (15-25% void spaces) reduces heat storage capacity. The lighter colors of some porous pavement systems reduce the heat absorbing capacity of the pavement. The open void structure in the porous pavement allows cooler earth temperatures from below to cool the pavement.

These factors allow porous pavement systems to approach natural ground cover in heat absorbing and storage capacity.

The proper conditions for use of the material must be present and proper instillation is vital to its successful use. In general, the use of pervious pavements should be limited to low-traffic areas. Only occasional truck traffic and no heavy semi traffic should be allowed. Also, pervious pavement requires an underlying soil/material of a porous nature. It is recommended that there is an underlying soil/material infiltration rate of 0.5-inch per hour at least 3 feet below the constructed material.

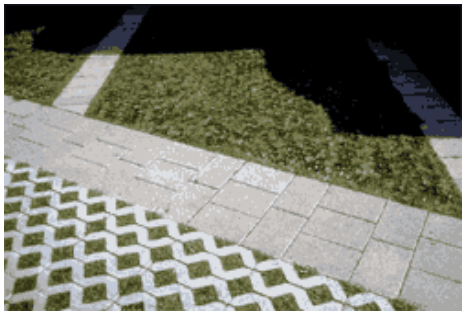
An excellent example of the use of pavers for a fire road, at new barracks, Clear Creek Road.

The use of pervious pavement is generally appropriate for the following conditions:

- Driveways, including residential driveways, low-traffic roads, fire lanes, service roads, and emergency access roads.
- Parking areas; especially overflow parking and those associated with administrative/office buildings, shopping areas and recreational facilities.
- Sidewalks and bicycle routes.
- Road shoulders and vehicle cross-overs on divided highways.
- Others, including pool decks, boat launching ramps and patios.

The following types of pervious pavement materials are considered appropriate for use at Fort Hood:

- Poured-in-place pervious asphalt which requires the same mixing and application materials and has the same 'blacktop' appearance of traditional impervious asphalt. Note the heat island effect of the asphalt must be considered.
- Poured-in-place pervious concrete surfaces which require similar construction machinery to standard concrete pavement.
- Block and concrete modular pavers designed to funnel water between blocks into a basement layer of washed sand and gravel where water slowly drains away through the soil. Pavers are best used for driveways, parking areas, shoulders along highways, roadway medians, boat launching ramps, emergency access roads, fire lanes, sidewalks, pool decks and patios.



Pervious pavement is designed to allow percolation or infiltration of stormwater through. A combination of pavement materials can be used to define areas.

- Grid pavers made from either recycled plastic or concrete. The grid pattern is usually honeycomb- or lattice-shaped and the voids collect water during rain events which slowly drains into the soil below. The grid pattern is filled with gravel and/or grass to create a visually appealing appearance. The flexibility of plastic type grid pavers allows their use at sites with an uneven topography. Grid pavers are ideal for natural landscape projects involving gardens or recreational areas that support both vehicular and pedestrian traffic and includes sidewalks, parking areas, golf cart paths, residential driveways, fire lanes and emergency access roads.

Soil pavement has many applications, one of which is for parking.

An alternative pavement material that will be considered for use at Fort Hood is Soil pavement. Although it is not a porous material, it does alleviate the heat island effect. The process converts the earth, itself, into a solid pavement by using existing in-place soil or a suitable imported soil for 98% of the pavement construction. This provides a palette of nature's earth tones, colors and hues. Soil pavement has many traffic area applications and non-traffic area applications such as service roads, parking lots, patios and picnic areas, and paths and walkways.

9.3 ROADWAY HIERARCHY

The roadway network of the installation should functionally and visually reflect a logical hierarchy of traffic circulation. The network should separate types of traffic by function and volume, ranging from through-traffic to local traffic. The visual character of each segment of the network should appropriately convey its role and function within the overall network. The basic network is classified as follows in terms of the type, character, and appearance of the road.

Highways. Highways provide primary high-speed traffic access to, around, or through a military installation. Design characteristics includes:

- Continuous, relatively straight or large radii curvilinear alignments that carry high-speed through-traffic movement between major activity centers within a region.
- A minimum of two lanes in each direction typically divided by a median or median divider.
- Alignments that border land use areas, rather than bisect them, and green space buffers between the road and adjacent uses.

- Controlled access onto the road.
- Either grade-separated or at-grade channelized intersections with traffic signal controls.
- Shoulders for emergency stopping, but strict prohibition of on-street parking.
- Street signing, lighting and planting that reflects the high-speed nature of traffic movement.
- Frontage roads at key locations.
- Pavement design for heavy loads and equipment transfer.
- Aesthetic treatment at intersections and key locations.
- Provisions for noise controls, such as sound walls near sensitive receptors (residential areas) and use of pavement surfaces that reduce noise.
- Stormwater management using low impact development processes (see Table 10-1).

A primary road with concrete median helps with traffic flow

A primary roadway bordering the Troop Housing Zone utilizes one-way streets with a wide medians used for parking

Primary roadway with landscaped median

A secondary roadway with no curb and gutter and a grass drainage swale is a good option

A tree lined secondary roadway with curb and gutter and a sidewalk

Primary Roadways. These are arterial routes that connect major activity centers, provide the primary access through the installation, and provide the means by which most people view the installation. These roadways often traverse the entire installation and carry the heaviest volume of traffic that results in high-speed and high-visibility corridors. Direct access to this type of road should be restricted to crossing at major intersections.

Primary roadways are designated as boulevards in urban areas and as avenues in rural and suburban areas. Design characteristics include:

- Continuous, through-traffic alignments that are relatively straight or large-radii curvilinear to handle moderate to heavy traffic.
- Alignments that form the boundary between different land uses are preferable to alignments that transect a land use zone.
- Two or more moving lanes in each direction, typically divided by a median.
- Controlled access and a minimum of curb cuts limited to entranceways to major facilities or building groups.
- At-grade intersections with signal controls and ADA-compliant crossings.
- On-street parking prohibited.
- Medians, street lighting, signing, and planting that enforces the moderate- to high-speed nature and importance of the road. Medians should, when applicable, be planted with trees to shade roads and sidewalks.
- Unless otherwise determined, provide curbs and gutters in all cantonment areas and residential areas.
- Stormwater management using low impact development processes (see Table 10-1).

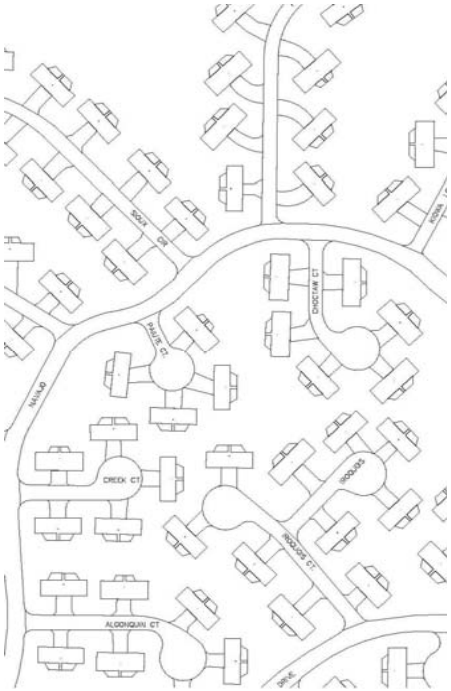
Secondary Roadways. Secondary roadways serve as connectors between primary roads and tertiary roads and typically connect primary roads to adjacent land use zones. Secondary roads accommodate moderate to slow traffic speeds with one moving lane in each direction. On-street parking should be prohibited and left-turn lanes should be provided at intersections with primary roads. Design characteristics include:

- Continuous through-traffic alignment between primary roads, either straight or curvilinear based, upon the design speed topography and land pattern.
- Direct access to abutting property.
- A maximum of two moving traffic lanes in each direction, either undivided or a boulevard with a planted median.
- On-street parking generally prohibited.
- Sidewalks should be separated at least two feet from the road by a planting strip.
- Street lighting, signing, and planting that reflect the moderate-to slow-speed nature of traffic and the character of the land use area. When possible, trees should be planted to provide shade for roads and pedestrians.
- Unless otherwise determined, provide curbs and gutters in all cantonment areas and residential areas.
- At-grade intersections with stop signs or signal controls; ADA compliant.
- Use of pavement materials that reduce sounds and lower hydroplaning.
- Stormwater management using low-impact development processes (see Table 10-1).

Tertiary Roadways. Tertiary roadways provide access to individual facilities, parking and service areas. They are designed to handle slow-speed, low volumes of traffic, with one lane in each direction. Tertiary roadways make use of “T” intersections and cul-de-sacs to reduce through-traffic, promote safety, and limit noise impacts from truck traffic. Design characteristics include:

- Alignments designed to discourage through-traffic.

Tertiary roadways surround this warehousing development and connect parking areas and roadways



Cul-de-sac roadway alignment can be most commonly found in the Family Housing Zone

Tactical vehicle trails that run parallel with secondary roadways keep the two vehicle types separate.

- Alignments that are relatively short, straight or curvilinear, and keep with topography, land use, and the slow-speed nature of traffic.
- Generally, a maximum of two moving traffic lanes, one in each direction.
- On-street parking allowable on an infrequent overflow basis by the addition of a parallel parking lane or bay.
- Unless otherwise determined, provide curbs and gutters in all cantonment areas and residential areas.
- Sidewalks may be limited to one side, depending upon need.
- Street lighting, signing, and planting that reflect the slow-speed nature of traffic and character of the land use area within which the road is located.
- Stormwater management using low impact development processes (see Table 10-1).

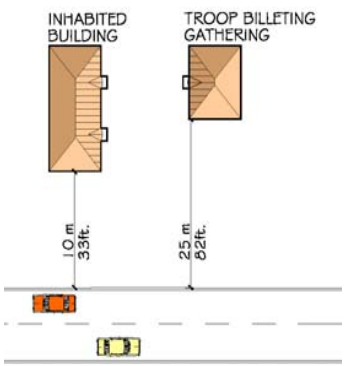
Cul-de-Sacs. Cul-de-sacs are short, dead-end tertiary streets located primarily in residential areas. They connect at one end to a tertiary or secondary street and have a turnaround at the other end, providing direct access to an abutting property while preventing through-traffic. Design characteristics include:

- Short, straight, or curvilinear alignment to serve abutting property.
- Generally, a maximum of two traffic lanes, one in each direction.
- Generally, a maximum length of 600 feet, except in areas where terrain and low density justify a longer length.
- Turnarounds must include a diameter to accommodate fire and garbage trucks.
- Turnarounds may be either symmetrical or offset.
- Turnarounds should have center planting islands to reduce the expanse of paved area.
- Overflow parking may be provided on-street in parking bays or within center of turnarounds.

- Sidewalks, if any, are generally limited to one side of the road. Sidewalks should be present in areas where circulation from one area to another is prevalent.
- Unless otherwise determined, provide curbs and gutters in all cantonment areas and residential areas.
- Street lighting, signing, and planting reflect the slow-speed nature of traffic and character of the land use area being served.
- Stormwater management using low impact development processes (see Table 10-1).

Tactical Vehicle Trails. Tactical vehicle trails provide alternative access for armored vehicles and other vehicles utilized in combat readiness training. They are recommended for installations with high use of armored vehicles to enhance the movement of the vehicles and reduce traffic congestion on the other installation roadways. These trails provide one-lane access for vehicles between motor pools and maneuver areas. It is recommended that these trails be hard-surfaced within developed areas with concrete of a thickness to withstand the weight of armored vehicles. The hard surface would reduce dust pollution, and The planting of trees and shrubs would aid in the reduction of dust from these vehicles. These trails should be designed to provide access that is as direct as possible, while minimizing crossings with primary, secondary or tertiary roads. All crossings with the other roadway systems should be clearly marked with signage and paved with concrete to support the weight of the vehicles.

Most tactical vehicle trails in the Rangeland Zone are not paved.



9.4 ROADWAY SETBACKS

Department of Defense Antiterrorism standards state that all inhabited buildings within a controlled perimeter will be set back a minimum of 10 meters (33 feet) from roadways and that troop billeting and primary gathering spaces will be set back a minimum of 25 meters (82 feet) from roadways. For inhabited buildings not within a controlled perimeter the minimum setback distance is 25 meters (82 feet), and for primary gathering places and troop facilities the minimum distance is 45 meters (148 feet) (see Unified Facilities Criteria (UFC) 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*, Table B-1 for more information).

Blend road drainage ditches into the natural landform.

Utilize native vegetation to replant disturbed areas

9.5 ROADWAY SYSTEM DESIGN

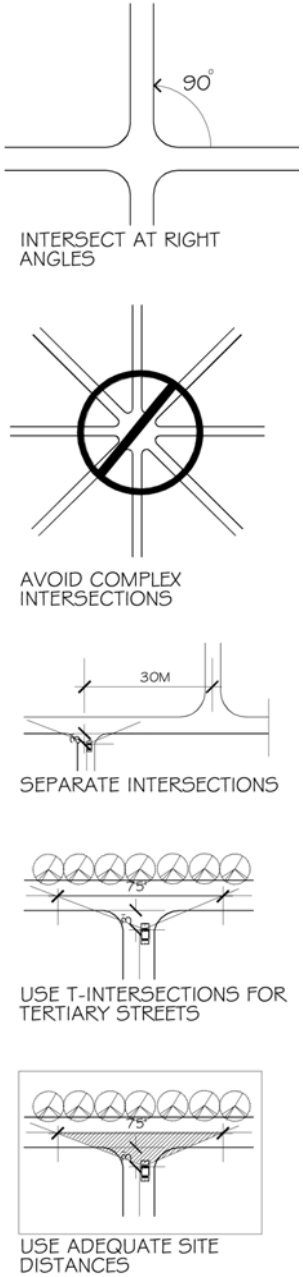
The location and design of new circulation system alignments, as well as improvements to the existing system, should be prepared to promote development sustainability. They should be designed to minimize impacts, relieve driver monotony, and provide a positive visual experience for the user without compromising safety. The following design techniques should be applied to circulation system design:

- Blend circulation with natural landform. The horizontal and vertical alignment of roads, walkways, and bikeways should minimize landform disturbance and blend with the natural setting.
- Minimize cut-and-fill by avoiding steeping terrain and aligning roadway, walkway, or bicycle systems to cross slopes diagonally or parallel to the contours rather than perpendicular to the contours.
- Mold cut-and-fill slopes to blend into the natural landform.
- Blend road drainage ditches, swales or channels into the natural landform.
- Use cluster development wherever possible to limit the lengths and required intersections of roadway and other circulation system elements, and to preserve land. Consideration should be given to meeting antiterrorism requirements when developing cluster type facilities.
- Minimize pedestrian, railroad, and bikeway crossings of highway, primary and secondary roads.
- Use natural topographic conditions to create grade-separated pedestrian, railroad, and bikeway road crossings wherever possible, especially on highways and primary roads.
- Provision of separate utility corridors along roadways (typically 10 to 15 feet).
- Adapt circulation to preserve vegetation. Design roads, walkways, and bike paths to minimize disturbance to existing vegetation, encourage re-vegetation with native plant material in disturbed areas, and reduce the visual impact of landscape disturbance.
- Align roads through open areas rather than forested areas.

- Minimize cut-and-fill to reduce the limits of clearing.
- Clear only for sight distances rather than uniform right-of-way clearing.
- Utilize tree wells or retaining walls to preserve specimen trees or significant vegetation areas.
- Provide optimum conditions for re-vegetation by following proper planting and maintenance techniques.
- Restore vegetation to disturbed areas using naturalistic plantings of native plant material (see Section 10.5).
- Locate roadway alignments to minimize the impact of traffic-emitted pollutants on adjacent development. This can be accomplished by the following:
  - Locate roads adjacent to land uses that are minimally affected by traffic-emitted air pollutants.
  - Reduce the impact of traffic-emitted pollutants on more sensitive land use areas by locating the roadways downwind and/or providing planted buffers. Tactical vehicle trails should be hard-surfaced to reduce dust pollution.
- Design and locate roadways to reduce the impact of traffic noise pollution on adjacent development.
- Roads should be physically separated from sensitive land uses, including residential, medical, educational, recreational, administrative, religious, library, community, or child care facilities.
- Utilize noise abatement techniques such as berms and sound barrier walls to reduce noise levels.
- Re-route truck and tank traffic to roadways adjacent to less noise-sensitive land uses. Tracked vehicle traffic should, ideally, be routed to a system of tank trails that are totally separate from corridors used by wheeled traffic vehicles.
- Provide stormwater management that is designed to reduce the post-development runoff rates to pre-development rates for the 2-, 10-, 25-, 50-, and 100-year design storms.

Utilize tree retaining walls to preserve specimen trees

The use of berming is helpful for screening unwanted noise



Intersection Design

- Use alternative paving materials that are more pervious than traditional paving materials (see Section 9.2).
- Incorporate LID stormwater design techniques (see Section 10.4.2).
- Provide gravel for tank trails, in lieu of concrete, or provide concrete pavement at turns only.

9.6 INTERSECTIONS

Safe intersections are an essential element of an installation circulation system. Intersections are the most dangerous areas of the installation circulation system. They should be planned or improved to provide safe and efficient traffic flow for both pedestrian and vehicular traffic. The following design techniques should be used to plan or improve intersections:

- All roadways should intersect at right angles (90 degrees), although 85-95 degrees is acceptable.
- Avoid dangerous, complex intersections of more than two streets intersecting at one point or offset intersections.
- Design intersections to reduce back-ups, as well as noise pollution and air pollution from increases in vehicle idling times.
- Provide proper drainage and eliminate excessive ponding with catch basins (inlets) at critical locations.
- Provide a smooth transition between intersecting streets to eliminate bumps from cross slopes.
- Avoid locating drives within close proximity of intersections (100-200 feet, depending on roadway classification).
- Proper signal timing (for peak and off-peak hours) and lane configurations.
- Eliminate intersections that are close to one another. They should be no closer than a minimum distance of 30 meters (100 feet).

- Use T-intersections for tertiary road intersections with secondary or primary roads to reduce conflict and promote safety.
- Provide turning lanes at all intersections along primary roads to eliminate interference with through-traffic flow.
- Minimize intersections along primary roads to reduce points of conflict and increase safety. Existing intersections with secondary and tertiary streets can be eliminated by the use of cul-de-sacs, with traffic routed along parallel streets to primary and secondary streets.
- Include adequate sight distances to meet minimum standard requirements at all intersections. The location from where the driver is waiting to cross or enter a traffic lane to a point 23 meters (75 feet) down the centerline to the right and the left should form the sight triangle.
- Minimize pedestrian and bicycle intersections with primary streets.
- Provide crosswalks at all intersections where necessary. Crosswalks should be marked with paint or vinyl strips or identified with a different paving surface, and should be signed with pedestrian crossing signing.
- Provide pedestrian access for persons with disabilities in accordance with the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and the Uniform Federal Accessibility Standards (UFAS). In the event of a conflict, the most stringent standards will be applied.
- Intersections between railroad tracks and high-speed roads must be signaled, well-marked, and have a smooth transition. All other road crossings must be well-marked and have a clear line of sight down the tracks. If signalized, ensure that vehicles are not trapped in the track area when traffic is stopped.

9.7 ENTRANCE GATES

The location and design of the installation entrance gates is a primary component of the installation circulation system. Entrance gates must be designed to be functional, while providing security protection not only for the installation itself, but also for personnel and others waiting to be admitted to the installation. Gates should be designed as a visual amenity to provide an aesthetically pleasing entrance to and exit from the installation. Planting schemes should be used to improve the aesthetics

and force protection issues regarding entries. Earthen berms along with trees, native stone, and shrubs would be a formidable barrier. Native grasses should be used to augment any of these schemes (see Section 12, Force Protection, for information on the design standards for installation gates).

9.8 PARKING REQUIREMENTS

The total quantity of parking in any one location will vary with the needs of the facility. The following are general considerations considering parking requirements.

- All parking lots will be accessible to persons with disabilities in accordance with the requirements of the UFAS, paragraph 4.1.1(5)(a). If parking spaces are provided for employees or visitors, or both, then accessible spaces will be provided in conformance with the required minimum number of accessible spaces shown in Table 9-1.

- For initial planning and programming, allocate 450 square feet of parking lot area per car. The total provides adequate minimum space for the parking spaces, access drives, and planting islands that make up a parking lot. This allocation is notwithstanding tactical military vehicles. There should be a landscaped area equal to or greater than 12% of the total gross square footage of the parking areas paved surface in parking areas.

- Minimize parking space requirements of a facility by selecting a site that will allow the sharing of parking with compatible activities.

- Multiple small parking lots are usually preferable to a single large lot because they enhance the visual environment by increasing the percent of landscaped area to paved area and allow more conformance to natural topography.

- The monotony of large parking areas can be altered by the use of designs such as curvilinear parking or the introduction of large planting islands.

- Promote means of access other than vehicular by providing alternative means of access such as walkways and bikeways.

- Provide bicycle storage and security to encourage alternative access.

Table 9-1
Required Minimum Number of Parking Spaces Accessible to Persons with Disabilities

Total spaces in parking areas	Required number of spaces
1-25	1
26-50	2
51-75	3
76-100	4
101-150	5
151-200	6
201-300	7
301-400	8
401-500	9
501-1000	2% of total
1001 and up	20 plus 1 for each 100 over 1000

9.9 PARKING LOT LOCATION AND DESIGN

- Parking areas can be designed and enhanced to provide a more pleasing impact and a more comfortable physical experience for the user. The following design techniques should be used to create more aesthetically pleasing, physically comfortable parking lots:
- Locate parking lots between and behind buildings to reduce the visual impact from the circulation system.
- Locate parking lots on relatively level areas to avoid excessive cut-and-fill.
- Design parking lots to be efficient in the design and the placement of access drives and parking spaces. All drives providing direct access to parking spaces should provide spaces on both sides of the drive.
- Provide planting areas at the ends of all rows of parking spaces. Provide islands with trees within the main parking lot to soften the visual expanse of the parking lot and to provide shade and/or wind breaks. Use open curbs around islands to provide a drainage outlet. Where feasible, parking islands should run perpendicular to the slope. Curbs around islands should have breaks on the up-hill side of the island, where stormwater sheet flow can penetrate the island and infiltrate the soil.
- Use natural topography and existing trees to visually screen parking areas from adjacent facilities and other parking bays.
- Design parking lots to preserve significant existing trees. Provide a planting area around the tree that is large enough to allow water to the root system. Avoid drip lines (see Section 10.10.2) during construction to prevent damage to the root systems.

Good parking lot design incorporates vegetation, pedestrian circulation and accessible spaces

Provide easy access by incorporating sidewalks from parking lots to facilities

Provide islands with trees within the main parking lot to soften the visual experience

Pervious pavement was used at this historical chapel at Fort Hood

- On-street parking along primary and some secondary streets should be avoided because it reduces the vehicular carrying capacity of the street, is visually unattractive, and is unsafe. If on-street parking is provided on secondary or tertiary streets, pedestrian bulbs should be built along intersections where sidewalks meet the street.
- Parking lots should be paved with concrete, asphalt, or other paving material with consideration and preference to the use of pervious paving material (see Section 9.2). Unless otherwise determined, provide curbs and gutters in all cantonment areas and residential areas.
- Parking structures, both below grade and above grade, provide for greater parking capacity in densely developed areas where available land is scarce. Parking structures are expensive, but provide a number of benefits, including efficient land use, reduced visual impact, and protection of vehicles from inclement weather. If parking structures are built, they will be designed to meet antiterrorism requirements.
- Provide admixtures/pigmentation within concrete pavement areas to produce a light-colored surface, where practical.
- Incorporate LID stormwater design techniques (see Section 10.4.2) for stormwater management. Incorporated LID practices will be used for landscape irrigation.
- Landscaping will be designed for low maintenance (see Section 10 for more information).

PARKING AREA DESIGN GUIDE

A comprehensive parking area design guide that includes siting, parking area types, geometry (parallel, perpendicular, angled), access, and maintenance considerations is located at the following website: U. S. Air Force Landscape Design Guide, Section 14, Parking Areas.

ANTITERRORISM SETBACK REQUIREMENTS

Parking lots within a controlled perimeter will be located a minimum of 10 meters (33 feet) from inhabited structures and 25 meters (82 feet) from troop billeting and primary gathering structures. Parking lots without a controlled perimeter will be located a minimum of 25 meters (82 feet) from inhabited structures and 45 meters (148 feet) from troop billeting and primary gathering areas (UFC 4-010-01, Table B-1). Designated parking for family housing located within secured perimeters with access control is excluded from the 25-meter (82 feet) setback requirement.

Table 9-2
Parking Lot Antiterrorism Setback Requirements

Facility	Parking Setback
Parking lots with controlled perimeter	10 meters (33 feet) from inhabited structures
Parking lots with controlled perimeter	25 meters (82 feet) from troop billeting and primary gathering areas
Parking lots without controlled perimeter	25 meters (82 feet) from inhabited structures
Parking lots without controlled perimeter	45 meters (148 feet) from troop billeting and primary gathering areas
Parking for family housing within secured perimeters with access control	Excluded from the 25 meter (82 feet) setback requirement

9.10 SERVICE AREAS

Facilities that require pickups and deliveries should have a service area that provides easy access to a loading dock exclusively for service vehicles. These areas should be designed to provide direct, easy access for vehicles and not conflict with railroad operations. Service areas should be screened from public view to reduce negative visual impacts. Service areas will meet all antiterrorism requirements.

9.11 DROP-OFF AREAS

Drop-off area for a medical clinic

Facilities that include a high percentage of persons arriving as vehicle passengers should include a vehicle drop-off area for users. Included are buildings such as headquarters, child development centers, schools, dining facilities, and clubs. Antiterrorism standards state that the access drive must be clearly defined and marked, that their intended use is to prevent parking of vehicles in those areas, and that drop-off lanes will not be located under any inhabited portion of a building (UCF 4-010-01, paragraph B-1.4). It is recommended that physical barriers be used to define the drop-off areas. These barriers may include curbing, planters, or other barriers together with signage to identify and restrict access. When possible, native stones of adequate size can be used as aesthetic barriers to entries. The driveway should be configured so that vehicles can be restricted during times of high alert. Access to the driveway should be located outside the standoff area with the initial approach parallel to the building, or a barrier must be utilized to prevent direct vehicular movement toward the building.

9.12 WALKWAYS AND PEDESTRIAN CIRCULATION

Walkways provide connections for pedestrians between buildings and ancillary facilities such as parking lots and other areas. Well-designed and located pedestrian walkways also provide a desirable alternative to total dependence on motor-driven vehicles.

Walkways are heavily used in the Troop Housing Zone

The goal is to encourage the use of walkways as an alternative means of circulation. Pedestrian walkways should be designed and located to provide a comfortable, enjoyable experience for the user. The use of walkways within the installation promotes development sustainability by conserving energy, reducing air pollution, and decreasing the land requirement for parking. These walkways also provide a means to increase physical fitness.

In order to achieve this goal the following objectives must be met:

- Provide walkways that are designed at a pedestrian scale to be comfortable and pleasant.
- Provide safe and secure pedestrian facilities that are separate from vehicular and railroad traffic.

Walkways should have a comfortable setback from the roadway to create a safe environment

- Provide amenities for pedestrians (e.g., benches, shade).
- Provide accessibility to all users, including physically impaired or challenged persons. All street and driveway crossings will be ramped, marked, and accessible to persons with disabilities in accordance with requirements of the UFAS. See the following UFAS paragraphs for the respective standards: Curb Ramps, paragraph 4.7; Ramps, paragraph 4.8; Stairs, paragraph 4.9.
- Provide links to major attractions and generators of pedestrian traffic.
- Provide design consistency throughout the walkways and ensure the walkways are well-drained.

Walkway Network Hierarchy

Sidewalks are classified to conform to the hierarchy roadway system - primary walkways, secondary walkways, and tertiary walkways. Non-roadway oriented sidewalks should be sized and placed where people will use them, thus, minimizing the creation of worn “shortcut” paths. Railroad track crossings should be avoided, but where necessary, they should be well-marked and have good line of sight. Walkways through railroad track ballast should be maintained with small, well-drained rock.

Primary Walkways. Wherever possible, primary walkways should be placed along both sides of primary roadways within the cantonment areas. These walkways should also be used for high volume pedestrian routes to facilities, and should be designed along axis lines relating to adjacent building entries, plazas, or streets. They should be paved with concrete, brick, or other pavers with consideration and preference to the use of pervious paving material (see Section 9.2)

Primary walkways should be sized to accommodate anticipated pedestrian use. They should have a minimum width of 1.8 meters (6 feet) and a maximum width of 3 to 3.5 meters (10 to 12 feet) in high use areas.

Secondary Walkways. Secondary walkways should be provided along one or both sides of secondary and tertiary streets. They are designed to carry moderate volumes of pedestrians between activity centers and housing areas. They should provide access to building entrances, plaza areas, or streets. They should be paved with concrete, brick or other pavers with consideration and preference to the use of pervious paving material (see Section 9.2)

These walkways should be sized to accommodate anticipated pedestrian use with a minimum width of 1.8 meters (6 feet) and a maximum width of 3 to 3.5 meters (10 to 12 feet) in high use areas.

Tertiary Walkways. Tertiary walkways provide pedestrian walkways in recreational and scenic areas for casual walking and hiking. They can be paved with concrete or bituminous asphalt or constructed with woodchips (Note: when paving with a hard surface material [e.g., concrete] preference is for the use of pervious paving material [see Section 9.2])

The layout of the walkway should have a meandering and curvilinear alignment. Paved walkways should have a minimum width of 1.2 meters (4 feet). Wood chip trails should have a minimum width of 1.2 meter (6 feet). Where paths are designated for use by bicyclists and pedestrians, these widths should be increased an additional 3 feet for each bike lane.

Some types of wood mulch are available through the Solid Waste Contract. Contact the Solid Waste Program Manager for details: (254) 287-9184 or (254) 287-6499.

Primary walkways located along a primary roadway

Secondary walkways which connect activity centers

Tertiary walkways in this natural area are used for hiking and physical training

Landscape helps define this walkway

Landscape deters pedestrians from veering off the walkways

When possible, separate the bikeways from the roadways

Troop Running Trails. Troop running trails should be provided for soldiers both in and out of formation. The width should be 4.5-5 meters (approximately 15 feet) to provide the width necessary for four soldiers abreast with a cadence caller. Primary, secondary and tertiary walkways can be designed to provide this function.

Troop Movement Paths. In locations where troops need to move four abreast (i.e., troops marching in formation between classrooms, barracks/dinning hall facilities), a hard surface walkway of adequate width should be provided.

Site Amenities at Walkways

Utilize site furnishings to reinforce the walkway system hierarchy. Provide directional and informational signage, where appropriate. Locate site furnishings such as benches, tables, waste receptacles, drinking fountains, and signage in response to travel distance and traffic volume.

Site furnishings should be placed at regular intervals along walkways, parallel to the walk and facing the flow of pedestrian traffic.

Landscaping at Walkways

Use a combination of canopy and ornamental trees along sidewalks to provide shade, define the path, provide visual interest, and discourage the creation of “shortcuts.” Utilize evergreen buffer plantings to screen harsh winds and undesirable views. Ensure plantings are not so dense as to create poor visibility, hiding places, or unsafe areas. Discourage the use of flowering/fruit-bearing trees and shrubs along walkways due to the threat of insects or fallen fruits littering the walkways.

9.13 BIKEWAYS

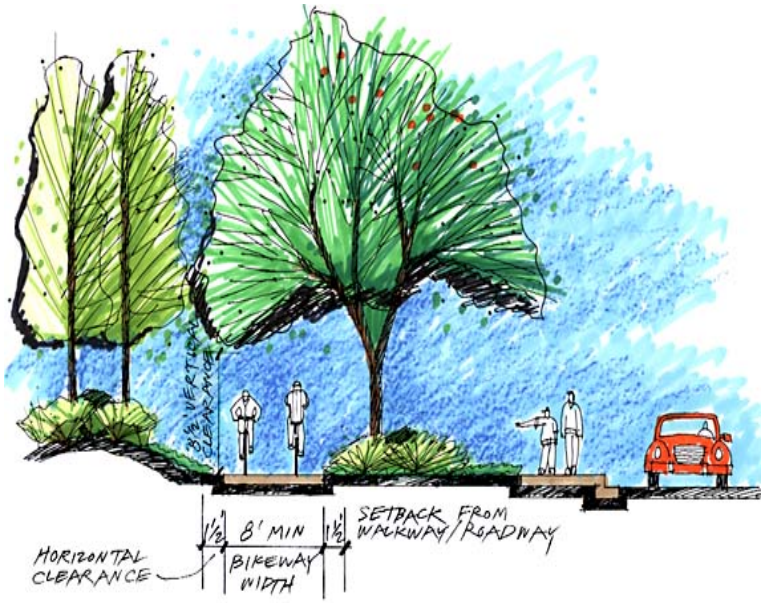
The use of bicycles as alternatives to the automobile has become more acceptable to installation personnel. This trend is encouraged as a method of reducing the automobile vehicle trips within the installation and reducing the need for greater carrying capacity. Also, cycling is a popular recreation activity that is enhanced by the availability of a safe and well-planned system of bike trails.

A bikeway system should provide direct routes between primary traffic and destinations within the installation. This network should be continuous and minimize conflicts between bikes, pedestrians, and vehicles. Bikeways should be planned and designed according to the classifications that define the level of separation they maintain from roadways and walkways. The ideal solution for the development of bikeways is to physically separate them from both roadways and walkways.

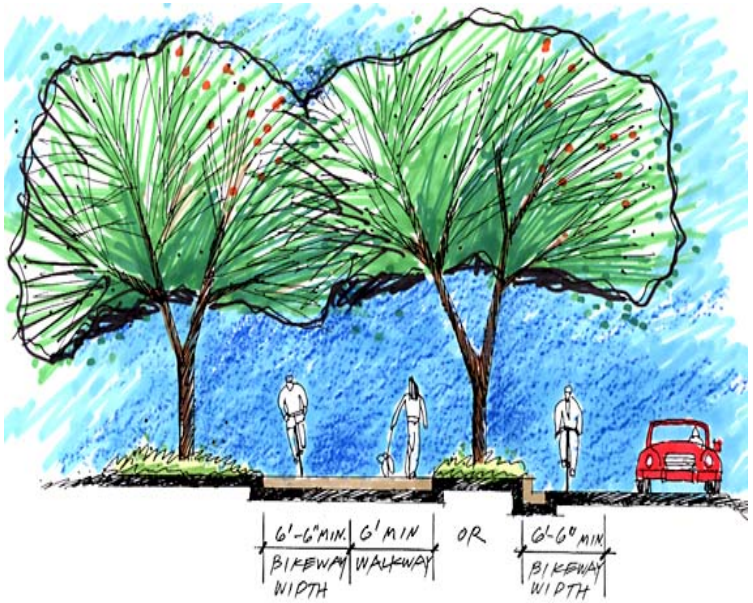
Bikeways are designed according to the following classifications:

Class I Bikeway. A Class I Bikeway is intended for the exclusive use of bicycles. While it may parallel a roadway, it is physically separated by distance or a vertical barrier. Class I Bikeway considerations include the following:

- Class I Bikeways provide the safest and most efficient means of bicycle travel and is the preferred option for bikeway development.
- Crossing of a Class I Bikeway by pedestrians, trains, or automobiles should be minimized.
- If a Class I Bikeway does not closely parallel a roadway, it should be designed to provide appropriate bikeway gradient and curvature.
- Class I Bikeways require the greatest amount of space and advance planning to reserve land and assure appropriate routing.
- Railroad crossings should be well-marked, with proper operating signals and clear sighting down the tracks. Road-crossing transitions should be smooth and well-drained.



Class I Bikeway



Class II Bikeway

Class II Bikeway. A Class II Bikeway shares the right-of-way with a roadway or walkway. It is indicated by a bikeway pictograph on the pavement as well as a continuous strip on the pavement, a continuous or intermittent curb, or other low barrier. Class II Bikeway considerations include the following:

- Because some separation is provided for bicycle travel, a Class II Bikeway provides some level of safety for the bicyclist and pedestrian.
- While crossings by pedestrians or automobiles are discouraged, they are not as controllable as they are on a Class I Bikeway because the Class II Bikeway is adjacent to the walkway or roadway.
- Because Class II Bikeways are tied to the adjacent roadway or walkway, route selection is important to maintain appropriate bikeway gradient and curvature.
- Class II Bikeways generally require less space than Class I Bikeways because they follow the alignment of, and share the right-of-way with, a roadway or walkway.

Class III Bikeways. A Class III Bikeway shares the right-of-way with a roadway or walkway. It is not indicated by a continuous strip on the pavement or separated by any type of barrier, but it is identified as a bikeway with signs. Class III Bikeway considerations include the following:

- Because no separation is provided, there is a higher potential for safety conflicts between automobiles and bicycles and between bicycles and pedestrians.
- Class III Bikeways provide continuity within the bikeway network and designate preferred shared routes to minimize potential conflicts. To maintain safety for bicyclists and pedestrians, Class III Bikeways should be developed, if possible, only where automobile and pedestrian traffic is moderate to light.
- Because Class III Bikeways share the roadway or walkway, route selection is important to maintain appropriate bikeway gradients and curvature.
- Class III Bikeways require the least space because they share the pavement with a roadway or walkway.

Class III Bikeway

General Bikeway Guidelines

- Wherever possible, provide a designated right-of-way for bike traffic, separate from vehicular and pedestrian routes.
- Locate bikeway crossings away from vehicular intersections, with crossings marked on the street pavement.
- When separate bicycle rights-of-way are not feasible, designate bikeway lanes with paint on the right-hand side of roadways.
- Bikeways should never share undesignated space with roadways, except at crossings.
- Encourage use of the bicycle system by making trails visually attractive and providing pedestrian amenities in appropriate locations. Provide site furnishings such as benches, tables, waste receptacles, drinking fountains, and signage along paths. Location of these amenities should be in response to travel distance and traffic volume.
- Distribute shower and changing facilities to promote the use of bicycles.

Bicycle Storage. Provide bicycle storage racks in areas that can be visually supervised and are close to building entrances, high activity areas, major workplaces, and recreational facilities, while avoiding conflicts with pedestrian circulation. Bicycle storage areas should be covered, especially at barracks, and easily accessible to building entrances.

Landscaping. Use a combination of canopy and ornamental trees along bicycle paths for shade, route definition, and visual interest. Provide evergreen buffers to screen harsh winds and undesirable views. Ensure plantings are not so denselas to create poor visibility, hiding places, or unsafe areas.

Crosswalks. Provide crosswalks at all intersections of roads and walkways/bikeways. When laying out the crosswalk, consider the following:

- Extend walkway paving across the road in heavily used areas. Raised crosswalks eliminate the need for curb ramps in sidewalks.
- Provide a clear line of sight for motorist and pedestrians. Do not plant in sight lines. Walkways should meet the road at 90-degree angles.

- Adequate light should be provided.
- Provide barrier-free access at all intersections or used raised crosswalks.

Walkway and Bikeway Lighting Design. Roadway lights and building exterior lights can serve as walkway and bikeway lights. Solar cell lighting should be used when applicable. Maximum use will be made of multi-purpose lighting systems. Paragraph 10.4 of Technical Manual (TM) 5-811-1, Electric Power Supply and Distribution direct the following walkway and bikeway lighting standards.

- Intensities. Values are dependent upon whether walkways and bikeways are adjacent to roadways or are isolated from vehicular traffic.
- Adjacent to Roadways. Walkways and bikeways will be illuminated to not less than one-half the maintained illumination required for adjacent roadways. Areas having in grade, such as stairs and ramps, will require special treatment. Crosswalks in the middle of the block will be illuminated to 1.5 to 2 times the normal roadway lighting level.
- Remote from Roadways. Walkways and bikeways remote from roadways will have a minimum of 5 lux (0.5 foot-candle) average illumination measured in 10-foot levels. Pedestrian tunnels will have 40 lux (4.0 foot-candles), stairways will have 6 lux (0.6 foot-candles), and overpasses will have 3 lux (0.3 foot candles) illumination.
- Pole design. Where pole-mounted lights illuminate only walkways or bikeways, shorter poles are most suitable, but luminaire height will not be less than 10 feet. Construction will be such as to minimize vandalism by use of break-resistant lenses, tamperproof screws, and sturdy poles.
- Signs. The Federal Manual of Uniform Traffic Control Devices (MUTCD) provides standards signs and markings for bicycle lanes and related bicycle facilities (see the MUTCD, Chapter 9 and any applicable amendments for traffic controls for bicycle facilities standards).

9.14 ARMY STANDARDS

The cited Army Standards will be met:

- Americans with Disabilities Act Accessibility Guidelines (ADAAG), http://www.access-board.gov/adaag/html/adaag.htm
- Army Regulation (AR) 420-72, *Transportation Infrastructure and Dams*, http://www.hqda.army.mil/acsimweb/fd/policy/ar420_72/main/index_txt.htm
- Manual For Railway Engineering, http://www.arema.org/eseries/scriptcontent/custom/e_arema/pubs/2005_mre_order_form.pdf
- Manual of Uniform Traffic Control Devices (MUTCD), http://mutcd.fhwa.dot.gov/
- Technical Manual (TM) 5-811-1/Air Force AFJMAN 32-1080, *Electric Power Supply and Distribution*, http://www.usace.army.mil/inet/usace-docs/armytm/tm5-811-1/chap10.pdf
- Unified Facilities Criteria (UFC) *3-210-02,* Design: POV Site Circulation and Parking, http://www.hnd.usace.army.mil/techinfo/UFC/UFC3-210-02/UFC3-210-02.pdf
- UFC *3-230-18FA,* Design: General Provisions and Geometric Design for Roads, Streets, Walks, and Open Storage Areas, http://www.hnd.usace.army.mil/techinfo/UFC/UFC3-230-18FA/UFC3-230-18FA.pdf
- UFC *3-260-02,* Design: Pavement Design for Airfields, http://www.hnd.usace.army.mil/techinfo/UFC/ufc326002H/ufc3-260-2.pdf
- UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*, http://www.wbdg.org/ccb/DOD/UFC/4_010_01.pdf
- Uniform Federal Accessibility Standards (UFAS), http://www.access-board.gov/ufas/ufas-html/ufas.htm

9.15 REFERENCES

The following references are provided for guidance:

- UFC *2*-600-01*, Installation Design,* Chapter 9, http://knxas1.hsdl.nps.navy.mil/homesec/docs/dod/nps03-080504-01.pdf
- U.S. Air Force, Landscape Design Guide, Parking Areas, http://www.afcee.brooks.af.mil/dc/dcd/land/ldg/s14ParkingAreas/index.html
- U.S. Air Force, Landscape Design Guide, Walkways and Bikeways, http://www.afcee.brooks.af.mil/dc/dcd/land/ldg/s10WalkBike/index.html, Provides a comprehensive walkways and bikeways planning guide including sections on paving materials and gradients and curvature data.
- Chicago's Bike Lane Design Manual, http://www.bicyclinginfo.org/pdf/bike_lane.pdf, Provides a comprehensive series of technical drawings and design specifications for bike lanes.

A military installation's visual image is defined not just by architectural character and site organization, but also by an attractive, organized landscape design. The presence of plant material on the installation can greatly enhance the visual character and environmental quality of the installation. Landscape plantings can provide a simple and cost-effective enhancement to the general appearance of the installation. Plantings can add an element of human scale to open spaces and can be used functionally to screen undesirable views, buffer winds, reinforce the hierarchy of the circulation system, or provide a visual transition between dissimilar land uses.

Fort Hood's Landscape Design Standards include the selection, placement, and maintenance of plant material on the installation. All landscape design at Fort Hood will comply with force protection requirements and will be used to enhance the overall attractiveness of security elements (see Section 12).

The landscape of Fort Hood should reflect the principles embodied in the installation's mission statement.

EXISTING CONDITIONS

VISUAL CHARACTER: BUILT ENVIRONMENT

Development within the Cantonment area spans several periods of Fort Hood's history. As a result of removal and subsequent reconstruction of large blocks of development with little consideration given to landscaping, the Cantonment lacks visual continuity. This lack of order is visible at multiple

scales – from the Cantonment level down to the individual site level – where ad hoc landscape and circulation treatments, constructed from a wide variety of different materials, of varying qualities and levels of craftsmanship, and at different times, add to a quality of randomness uncharacteristic of a military institution. The only formality lies within the motor pools and other areas related to carrying out Fort Hood's mission. It should be noted that with an average of only 31 inches of rainfall annually, establishing new landscape is a challenge for Fort Hood.

DESIRED LANDSCAPE CHARACTER

The desired landscape character for Fort Hood is to help create a sense of visual order through the consistent application of landscape design principles and materials to developed areas of Fort Hood (Main Cantonment area, and North and West Fort Hood) and to the rangelands where landscape management practices, rooted in science, will be used to help stabilize and sustain plant communities and habitat. In doing so, the desired landscape character at Fort Hood will reflect the principles embodied in the installation's military mission (see Section 1).

10.1 LANDSCAPE OBJECTIVES

The "landscape" of Fort Hood is not a natural feature of the environment, but a man-made system of spaces superimposed on the land, functioning and evolving according to natural laws, and planned and designed to serve the military community of Fort Hood. The landscape of Fort Hood embodies not only the open spaces, the requisite ornamental plantings, site furnishings and other embellishments, but the built and natural environments, in their entirety, including buildings, circulation systems of roadways and sidewalks, vegetation, drainage and topography – a composition of land uses and the activities therein.

Urban Natural Area A characterizes the natural plant communities and drainage patterns native to Texas.

The standards, criteria, and recommendations for the Fort Hood landscape, as discussed in this section, focus on the use of landscape plant material to achieve the following objectives.

- Minimize impact to the natural environment/adopt an ecological systems approach:
  - Build an ecologically friendly landscape that supports biodiversity;
  - Use a planting design that preserves and enhances the natural character of the landscape, including landforms and existing vegetation;

- Protect and enhance the natural beauty and ecological value of the site;
- Minimize habitat disturbance;
- Control erosion through improved landscaping (bio-engineering) practices; and
- Improve the overall visual quality of the installation through the use of native plant material.

- Enhance environmental quality:
  - Provide scale and comfort to pedestrian environments;
  - Reduce urban heat islands effect;
  - Reduce ambient air temperature by incorporating existing trees and other vegetation to shade walkways, parking lots, and other open, pedestrian areas;
  - Value aesthetic decisions, such as the importance of views and the integration of natural and manmade elements; and
  - Screen unsightly views and elements.
- Create a visually and functionally uniform, coherent, and orderly environment:
  - Remove all unnecessary, extraneous landscape treatments and embellishments; and
  - Adopt a limited palette of landscape materials to be used throughout the installation, whereby a single material serves one specific landscape function (see Plant Palette, Appendix I).
- Extend the whole building or site systems approach into the landscape:
  - Use landscape enhancements to reduce climatic (temperature) extremes;
  - Ensure that site work and landscaping are integrated with security, safety, and sustainability objectives;
  - Shade as much hardscape as possible;

The overuse of concrete masonry unit planters and tree rings add to the ad hoc, unorganized appearance of the landscape.

A healthy grove of live oak trees, thriving within a natural depression. An example of applied low-impact development (LID) techniques, micro-detention basins should be constructed wherever tree planting occur.

- Shade playgrounds and picnic areas; and
- Cover the ground with as much vegetation as possible.

- Incorporate low-impact development (LID) principles (see Section 10.4.2):
  - Use vegetated swales, infiltration trenches, dry wells, and depressions to increase storage volume, to reduce, control, and facilitate infiltration, and to treat surface runoff;
  - Reduce water consumption; and
  - Utilize stormwater management ponds and dry hydrants.
- Adopt best maintenance practices:
  - Minimize costs and resource impacts of ongoing landscape management;
  - Minimize pollutant loading of groundwater and surface waters; and
  - Use a planting design and maintenance methods that reduce fertilizer and pesticide pollution by using integrated pest management techniques and recycling green waste.
- Enhance anti-terrorism capabilities (force protection considerations) through landscape treatments.

10.2 LANDSCAPE DESIGN PRINCIPLES

Adhering to the following design principles will enable the designer to consider the full range of applicable design solutions for a given project area, as well as its relationship to other areas, at a variety of scales.

10.2.1 Form (massing vs. specimen)

Form can be the shape of a plant; however, shapes are flat, forms are not. For example, a triangle is a shape, but a pyramid is a form. Upright, oval, columnar, spreading, broad spreading, or weeping are all examples or descriptions of a plant's form.

Some plants are most attractive when grouped together to create a larger form. In contrast to plant massing, some plants have characteristics that are best appreciated when they are planted alone, and viewed as a specimen, representing the best plant of its kind.

10.2.2 Spatial Articulation and Definition

Plants can be selected and placed to create enclosed spaces, to separate spaces from one another, or to create a sequence of spaces. Plants can also be used to direct people through space by visually defining and reinforcing spatial edges and patterns of movement. The degree of spatial enclosure, separation, or movement is dependent upon the densities, forms, and types of plants used.

10.2.3 Depth (foreground, middle-ground, background)

Depth refers to the distance front-to-back or near-to-far in a landscape scene. Because of their intricate or detailed form and fine texture, certain types of plants are best used closer to one's field of vision, in the foreground. Masses of plant material that are being used for their seasonal color, but lack other redeeming qualities may be best suited for use in the background or areas furthest from one's field of vision. Sometimes, plants possessing a particularly coarse texture can be used in the background to create the illusion of a foreshortened middle-ground.

10.2.4 Unity

The selection and placement of plant material can be used to blend, screen, and soften incompatible architectural or other unattractive visual impacts. Legibility and visual balance can be achieved through the uniform or repetitive use of similar landscape elements (i.e., same plant size, shape, spacing) opposing a central feature or axis. Plant material as a unifying element can be placed in front of a building or view to frame and enhance the visual impact.

10.2.5 Rhythm

Rhythm is the principle of design that refers to a regular repetition of elements to produce the look and feel of movement. It is often achieved through the careful placement of repeated components that invite the viewer's eye to jump rapidly or glide smoothly from one to the next. Repetition of a single plant or mass of plants provides visual interest and formality to the landscape. Rhythm produces emphasis and unity and is especially effective in articulating main circulation routes.

Landscape Design Principles:

- Form
- Spatial Articulation and Definition
- Depth
- Unity
- Rhythm
- Accent
- Scale
- Simplicity
- Contrast
- Color and Texture
- Ultimate Effect
- Security

10.2.6 Accent

Create an accent by providing a contrast in spacing or a visual break in the sequence or pattern of plant materials. Accent can also be created by changing plant form or by providing an abrupt color change in a plant material sequence. Accents can be achieved on a seasonal basis through flowers or changes in a plant's foliage.

10.2.7 Scale

In terms of landscape composition, scale refers to the ratio, or proportion, used in determining the dimensional relationship between a participant and other elements in the landscape. People feel most comfortable when the objects and spaces around them are of a size and physicality that they can relate to, whereby they can gauge dimension and distance relative to their own proportions. Sometimes scale is called "proper proportion." A good example of responding to issues of scale would be to plant a formal grove of trees within a courtyard that is framed by multi-story buildings. Spatially, the trees' canopies can provide the perception of a ceiling for the courtyard, effectively creating an outdoor "room," rather than allowing the sense of horizontal space to be overwhelmed by the height of the buildings.

10.2.8 Simplicity

This term refers to the practice of using a limited number of similar elements to secure a uniform appearance, thus minimizing the sense of clutter from having too many different kinds of elements.

10.2.9 Contrast

The term contrast refers to a way of combining elements in a landscape setting to stress the differences between those elements. Used in this way, contrast can excite, emphasize, and direct attention to points of interest.

10.2.10 Color and Texture

Use of color in planting design can be symbolic and purposeful. Color should complement surrounding elements of design, particularly nearby architecture. The use of color in a rhythmic pattern can create a sense of harmony. The use of delicate colors (tints and pastels) can provide a fine textural appearance, while the use of bright colors can imply a coarse textural appearance. The use of bright,

warm colors (reds, yellows, and oranges) can be used to excite and stimulate the senses, compared to the use of subdued or cool colors (blues and greens) to evoke a sense of rest and relaxation.

Texture is the perceived visual quality or "feel" of an object, its smoothness, roughness, softness, etc. Textures may be actual or simulated. Actual textures can be felt with the fingers, while simulated textures might be suggested by the distance the viewer is from the element. Value and contrast are often dependent upon the texture of the object. Texture is classified as either coarse or fine.

10.2.11 Ultimate Effect

The landscape plan should be prepared with consideration for the mature size of all plants. To account for spread as well as height, nursery industrial standards for mature material should be used to determine spacing for all materials. The ultimate height of the material should also be considered in relation to windows and other visual concerns.

10.2.12 Security

Design opportunities that meet security needs while improving the overall image of the installation and sites therein should be encouraged.

10.3 SITE ANALYSIS

Whether plans are to modify a building's interior or exterior climatic environmental conditions, to improve security and defensible space around a building's perimeter, or to visually enhance an area through the use of vegetation and other landscape enhancements, site-specific landscape plans that acknowledge both the limitations and the opportunities of existing site conditions – drainage patterns, solar orientation, circulation and use – are required. Just as important is the need to place the plan design within the site's surrounding context and examine the compatibility of proposed plants and other materials.

When preparing a landscape plan that will be incorporated into the overall site plan (see Section 7) consider the following steps:

- Analyze the soil conditions of each project site. Determine the nature of the soil, including its structure, proportion of clay, sand, silt, organic matter, nutrient content, pH, and the various soil strata to several feet down.

- Determine the direction of predominant wind patterns and how these patterns change through the seasons. Consider how breezes may be directed to cool the ambient temperature of the site. In contrast, consider the vegetative / other screening necessary to block or reduce the impact of predominant winds, if necessary.

- Examine the site's drainage patterns and whether surface and/or subsurface modifications may be required. Make sure that modifications are not in conflict with existing or proposed planting and / or circulation systems.

- Evaluate the health and viability of existing site vegetation and determine ways of incorporating it into the overall project. In natural rangeland areas, identify all the plants that compose the ecosystem, and their requisite function in supporting the system.

- Analyze infrastructural requirements needed to maintain proposed landscape improvements. Determine locations and access to available sources of water, as well as access to available electricity for landscape lighting improvements.

- When developing outdoor social gathering spaces, such as a plaza or a picnic area, determine sun angles, patterns, and amounts of exposure to sunlight throughout the day and how these patterns change through the seasons. Identify areas exposed to direct sunlight versus areas that benefit from reflected or indirect light.

- Analyze pedestrian and vehicular circulation in and around the site. Consider whether proposed landscape treatment may be in conflict with existing circulation patterns, as well as how these conflicts might be mitigated. Identify areas that have suffered from erosion or other impacts as a result of too much pedestrian or other traffic.

- Analyze the architectural detailing of adjacent building façades. Determine what features or elements are important and should be maintained in the overall visual composition, compared to what features detract from the composition and could be screened using plant material. Consider how sunlight penetrates adjacent buildings, through windows, entrances, and skylights. Consider ways of using plant material and other architectural elements to reduce the amount of direct solar exposure and radiant heat, while maximizing access to indirect light.

- Consider the level of security inherent in the site. Are there areas of the site where people and objects might be hidden? Determine how vegetation and other elements prevent full visual access to areas within the site.

10.4 SUSTAINABLE LANDSCAPE DEVELOPMENT

Enhancing the landscape to improve exterior living and environmental conditions and quality of place is an important and valued component of sustainable development and must be integrated with all aspects of building design, construction, and operation. Recognizing that sustained maintenance of plant material can be a time-consuming and costly enterprise, it is important that landscaping on the installation embrace the principles of xeriscaping, low-impact development (LID), and efficient irrigation practices. First and foremost, Fort Hood is committed to resource-efficient landscaping that considers the selection and use of appropriate native, drought-resistant, low-maintenance plant material. Secondly, vegetation should be used in conjunction with LID strategies, tools, and techniques for stormwater management in locations where the practical applications of rainwater harvesting systems, mulches, and other water-retention / detention techniques can greatly conserve water to sustain the vegetation. Finally, if an irrigation system is required, it should deliver the water closest to the points where it is to be used, during the right hours, and under the right conditions to prevent loss of water to evaporation and wind.

10.4.1 Xeriscape

Xeriscape landscapes are defined as "quality landscaping that conserves water and protects the environment." Xeriscaping is the conservation of water and energy through creative and adaptive landscape design. Xeriscape landscapes provide attractive solutions that save money, water, and maintenance. The following website provides guidance on specific design principles of the Xeriscape design process and Xeriscape design application: USAF Landscape Design Guide, Section 13, *Xeriscape*, at http://www.afcee.brooks.af.mil/dc/dcd/land/ldg/s13Xeriscape/index.html.

There are seven principles associated with Xeriscape™ landscapes:

1) Planning and Design
2) Soil Improvement
3) Appropriate Plant Selection
4) Practical Turf Areas
5) Efficient Irrigation
6) Use of Mulches
7) Appropriate Maintenance

Figure 10-1 Key elements of LID

10.4.2 Low-Impact Development

Low-impact development (LID) is a stormwater management approach with the basic premise that "nature knows best." Rather than collecting and conveying stormwater off-site through pipes and other conveyance systems, LID-designed sites use vegetation and small-scale hydrologic controls to capture, treat, and infiltrate stormwater on-site, helping to maintain the natural hydrology as development occurs. These landscape features, known as Integrated Management Practices (IMPs), are the building blocks of LID. IMPs can be integrated into buildings, infrastructure, or the landscape design. Almost all components of the built environment have the potential to serve as an IMP, including open space, streetscapes, parking lots, sidewalks, and medians. IMP approaches such as, micro basins, swales, berms, and bioretention areas can be used to retain both rainwater and irrigation long enough for the vegetation to benefit. Plants used within the stormwater harvesting basins/structures should be tolerant of occasional inundation in areas where ponding occurs.

Each prospective IMP should be evaluated to ensure maximum site suitability for each development and Fort Hood visual zone. A selection of the ranking criteria may include stormwater loading requirements, topography, land use, aesthetics, maintenance, and cost. Based on the outcome, one particular IMP may stand out as the logical choice or several IMPs may be appropriate. When selecting IMPs, preference shall be given to those that use natural systems, processes, and materials. Most IMPs should be designed to infiltrate all stormwater within 12 hours to prevent a mosquito problem. Permanent wet ponds are an exception to this rule. Inspections should occur on new IMPs following a storm event to ensure proper infiltration. Potential stormwater IMPs for Fort Hood are listed in Table 10-1. Table 10-2 is a matrix illustrating potential IMPs for each Fort Hood visual zone.

Subsurface drainage is not required to remove surface stormwater. shallow micro-detention basins should be created to retain stormwater for vegetation consumption and groundwater recharge.

Table 10-1 LID Integrated Management	
Bioretention (Rain Garden)	Vegetated depressions that collect runoff and facilitate its infiltration into the ground. If used in parking lots and roadway medians they can dramatically decrease off-site surface runoff. These have the added benefit of providing shade and decreasing parking lot and adjacent building temperature, thereby increasing energy efficiency in proximate facilities. They can be used on large sites and on small residential locations. Initial cost can be high for proper planning, design, and construction. Once the system is established, maintenance and cost should be minimal.
Grassed Swales	Shallow channels lined with grass used to convey and store runoff. There are many types and uses for grassed swales. They can provide water containment and slow runoff through a variety of designs and costs and are suitable for almost any site. Proper planning and design are key to their success. In general, grassed swales can be used to manage runoff from drainage areas that are less than 10 acres in size, with slopes of no greater than 5%. Little maintenance is required.
Permeable Pavers	Manufactured paving stones containing spaces where water can penetrate into the porous media placed underneath. These are appropriate for many residential, retail, and commercial locations. Permeable pavers are designed to have almost no runoff or pooling on the surface. They may have load restrictions and range in cost from moderately expensive to very expensive. Maintenance is required to ensure permeability.
Open Cell Pavers	Concrete or plastic grids with voids that are filled with a reinforced vegetative turf or an aggregate material like sand, gravel, or crusher fines. These are suitable for driveways, overflow-parking areas, and roadways/parking areas with load restrictions. They are usually the least costly pervious paving option available. They require periodic inspections to ensure the system is being maintained.
Permeable Pavement	Asphalt or concrete rendered porous by the aggregate structure. Continuous advances in permeable pavement have yielded dramatic benefits for groundwater recharge. There are limits to load capacity based on the pavement type and site characteristics. It may not be suitable for load-bearing roads or with heavy machinery. It is also unsuitable for areas where pollutant spills may occur as it has to be removed to clean the spill. Permeable pavement functions well in residential and commercial/retail areas. Cost is relatively expensive, but this IMP is effective at greatly reducing runoff on typically impervious areas. Proper design is key to achieving effective results.

Courtesy of R. Traver, Villanova Urban Stormwater Partnership.

Bioretention (rain garden) to treat parking lot runoff.

Open cell pavers used in a shopping center parking lot.

Example of a completed tree box filter.

Table 10-1 LID Integrated Management	
Rainwater Harvesting (Barrels)	The process of intercepting stormwater from a surface such as a roof and putting it to beneficial use. Water is usually captured and stored in rain barrels or cisterns. These can be low-cost, easily maintained systems (see Section 8.14.4).
Soil Amendments	Mineral and organic material added to soil to increase its capacity for absorbing moisture and sustaining vegetation. Amendments could be suitable on new development sites where soil has already been disturbed. Cost is dependent on availability and price of local organic material.
Tree Box Filters	Curbside containers placed below grade, covered with a grate, filled with filter media and planted with a tree in the center. Runoff is directed to the tree box, where it is filtered by vegetation and soil before entering a catch basin. These trees will eventually provide shade, habitat, and aesthetics. Choice of tree species can also result in numerous other benefits such as noise screening, more energy efficient buildings, street scale, and traffic calming. Maintenance is required to clean the filters periodically. The filter systems are often used to retrofit urban areas and can be costly to purchase.
Filter Strips	Bands of dense vegetation planted immediately downstream of a runoff source designed to filter runoff before entering a receiving structure or waterbody. Filter strips are particularly beneficial when located in medians and between roadways and sidewalks. They serve many purposes in this capacity such as protection for pedestrians, street scale, and runoff reduction. Cost to construct the filter strip is low and long-term cost and maintenance are also minimal when native plants and proper slope are utilized. When used in areas with clay soils, soil additives may be needed to allow ground infiltration.
Vegetated Buffers	Natural or manmade vegetated buffer areas adjacent to a waterbody that traps and filters sediment, nutrients, and chemicals from surface runoff. Buffers provide valuable benefits in almost any location and can also improve water quality. Utilizing native vegetation is key to keeping costs and maintenance low.
Microbasins	Depressions surrounded by a small semi-circular berm on gently sloping or nearly flat land. These do best in environments where there is low runoff volume such as along sidewalks, in parking lot planters, and in landscaped areas. They can be used in a series with spillways if the runoff volume is more concentrated. Minimal cost and maintenance are associated with microbasins.

Table 10-1 LID Integrated Management	
French Drains	Rock-filled trenches designed for rapid stormwater infiltration. French drains should be used in areas with limited sediment and low to moderate flows like rooftop drains/driplines and parking lots. Vegetated areas can be paired with French drains by constructing gravel columns between trees or directing the water to the planted areas. Proper initial design will ensure less maintenance for the drains.
Xeriscapes	Utilize native plants, design and mulch to create water-efficient, low maintenance landscapes. Xeriscapes are appropriate for most locations, particularly where aesthetics and water conservation are highly valuable. Cost and maintenance will be minimal once the vegetation is established.
Wet Ponds	Treatment system that contains stormwater and allows pollutants to settle out over a series of ponds. The ponds are often vegetated with hydric plants to increase effectiveness. Wet ponds require appropriate design and planning in order to function properly. In semi-arid conditions, the design should include a micro-pool or extended wet basin so they continue to function properly throughout the dry season. They also require regular inspections to ensure the outflow devices are functioning and cleared of debris. There is typically a high initial cost with wet ponds.
Benches	Series of grassy swales on a slope to slow runoff and promote recharge. Benches are most efficient in locations with a gradual slope. They can also be partnered with vegetation to create terraces for increased retention and aesthetics. When used in conjunction with wet ponds they can act as a safety feature. Aquatic benches are also used to provide additional safety as well as to provide an area for aquatic vegetation. Benches have relatively low cost and maintenance.
Inlet Pollution Removal Devices	Small stormwater treatment systems that are installed below grade at the edge of paved areas and trap or filter pollutants in runoff before it enters the storm drain. There are a variety of systems serving diverse purposes for treating stormwater. Type and size will be based on the site characteristics, runoff pollutants, and volume. Several systems can be used together to treat larger amounts of runoff. Maintenance is necessary to clean or replace the filters. Additionally, both the initial and long-term cost for these devices is relatively high.
Dry Wells	Gravel- or stone-filled pits that are located to catch water from roof downspouts or paved areas. These function much the same way that rain gardens do, although they may be more appropriate for larger areas. Avoid installation in large areas with high sediment loads and in soils with limited permeability. Dry wells are not appropriate for treating runoff from large impervious surface areas such as parking lots. The dry wells should be inspected periodically to check on any structural problems and to remove any debris that has collected.

Courtesy of the Center for Watershed Protection.

Combination of grassy bench, aquatic bench, and wet pond for stormwater treatment.

Courtesy of the Center for Watershed Protection.

Inlet pollution removal device (perimeter sand filter) to capture sediment and filter pollutants from parking lot runoff.

Courtesy of the Center for Watershed Protection.

Infiltration trench filters pollutants from runoff through the soil.

Table 10-1
LID Integrated Management

Infiltration Trenches	Trenches filled with porous media such as bioretention material, sand, or aggregate that collect runoff and exfiltrate it into the ground. These are best utilized in industrial locations where aesthetics is not a priority. They can be designed to manage a high concentration of runoff. Infiltration trenches require regular maintenance and inspection.
Detention Basins	Area where excess stormwater is stored or held temporarily and that slowly drains when water levels in the receiving channel recede. These are utilized in areas of heavy runoff concentration to control downstream flooding and contain the high flows for a limited amount of time. Possibly well suited to large impervious land uses such as industrial sites and airfields. Regular inspection and maintenance are required. Cost is correlated with the necessary stormwater capacity.

Table 10-2
Stormwater Management Related to Fort Hood Visual Zones

Fort Hood Visual	Integrated Management Practices																		
	Bioretention (Rain Garden)	Grassed Swales	Permeable Pavers	Open Cell Pavers	Permeable Pavement	Rainwater Harvesting (Barrels)	Soil Amendments	Tree Box Filters	Filter Strips	Vegetated Buffers	Microbasins	French Drains	Xeriscapes	Wet Ponds	Benches	Inlet Pollution Removal Devices	Dry Wells	Infiltration Trenches	Detention Basins
Family Housing	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓				
Troop Housing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
Maintenance and Warehouse	✓	✓				✓		✓		✓			✓	✓	✓	✓	✓	✓	✓
Community Core	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Recreation and Open Space	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓		✓		✓
Airfields	✓	✓		✓	✓	✓			✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Rangelend		✓							✓	✓					✓		✓		

The early incorporation of LID techniques into the site planning process (see Section 7) will not affect the site design strategy and can have numerous benefits. Incorporation of LID techniques can reduce the size and, therefore, costs of required retention/detention facilities, reduce landscaping irrigation needs, lower energy requirements for buildings by shading, and benefit water quality. Incorporating stormwater designs early in the planning stage of development is key to reducing costs and achieving long-term benefits.

Courtesy of the Center for Watershed Protection.

Example of rain barrel capturing roof runoff.

Additional information regarding LID practices can be found in UFC 3-210-10, Design: Low Impact Development Manual or by contacting 254-287-6499, The water conservation benefits of LID meet Fort Hood's 25-Year Sustainable Goal of providing high-quality potable water and reducing consumption while maintaining mission readiness and quality of life. The benefits also meet the water conservation goals established in the Water Conservation Plan and the Stormwater Pollution Prevention Plan (SWPPP). New projects, redevelopment projects, and capital improvement projects are all candidates for implementation of LID practices.

Aerial landscape spray irrigation systems are strongly discouraged, and should be replaced with a subsurface drip irrigation system.

10.4.3 Irrigation

Fort Hood's DPW generally discourages permanent irrigation system installation and use due to their potable water consumption as well as their maintenance requirements. It is recognized, however, that temporary irrigation systems are necessary to establish plants/turfs in newly landscaped areas, as well as plants in stormwater harvesting basins/structures. Temporary irrigation systems should be removed after the establishment period, usually in 12 to 24 months. Irrigation systems not sanctioned by DPW are prohibited.

The type of water system bested suited for the project depends on the landscape design and layout. When a permitted irrigation system is used, the selected system must deliver the water closest to the points where it is to be used to prevent loss of water to evaporation and wind. Temporary irrigation systems for plants shall consist of above ground drip irrigation. Drip irrigation systems are preferred because they more efficiently deliver water directly to the root area of the plants than do spray irrigation systems. In the event that spray irrigation is necessary for turf areas, use non-mist type low trajectory nozzles and pressure-compensating devices or for smaller turf areas use micro-spray, low flow heads. If a permanent irrigation system is needed, install a subsurface irrigation drip systems to provide water directly to the roots.

Whether the system is temporary or permanent, watering zones will be developed based on different conditions – shade, sun, wind, soil, and vegetation – to prevent irrigating areas that do not need additional water. Irrigation timers will also be used to ensure that irrigation is conducted only during appropriate times of the day to prevent water loss to wind and evaporation. Timers will be set to allow the system to operate during early morning or later evening hours only. Irrigation between 0800 and 1300 should be avoided to prevent water loss to evaporation. Irrigation between 1300 and 1700 hours is not permitted. A timer that allows for scheduling every 5-7 days (14 or 15-day programming) and independent zone programming capability is required.

Water loss to wind can be appreciable during 1300 and 1700 hours and gives further reason for avoiding it. To prevent water loss to wind, confine spray irrigation to as small of an area as possible, such as building landscaping and lawns. Spray irrigation will not be conducted if the wind gust velocity exceeds 10 miles per hour. The physical position of the water application should be reviewed during system commissioning to ensure that water is delivered only where it is needed. Water monitoring equipment should be used to determine efficient use of available water (see Section 10.4.3.2).

How does a soil tensiometer work? As the soil dries out, water is sucked out through the porous ceramic tip, creating a partial vacuum inside the tube that is read on the vacuum gauge.

For both temporary and permanent irrigation systems, Fort Hood requires the designer to first consider the use of rainwater harvesting or gray water capture systems for the purpose of irrigation (see Section 8.14).

Installed irrigation systems must be protected with a minimum of double-check backflow preventers.

10.4.3.1 Irrigation Operation and Maintenance

Periodically review all landscape service and maintenance agreements to incorporate high priority for water, chemicals, and energy conservation. Consider incorporating a performance standard for water use and other parameters into contracts. Establish a user-friendly method to report irrigation system problems and fix them immediately. Encourage landscape contractors to report and fix problems. A complete system audit should be conducted annually, and irrigation schedules adjusted quarterly at a minimum. (A training program for Irrigation Auditors is offered by the Texas Agricultural Extension Service.)

Verify that the irrigation schedule is appropriate for climate, soil conditions, plant materials, grading, and season. Monitor irrigation systems to maximize the effectiveness of watering while minimizing the amount of water used and the opportunity for fungus growth. Generally, it is better to water deeply less frequently than to water lightly often. Verify that emitters are appropriate to the plants being irrigated. In areas with plants, trees, or shrubs use sprinkler heads instead of turf sprinklers. Sprinkler heads shall be placed and adjusted so that they will water the landscape, not the pavement. Water plant roots, not trunks or leaves. Check for dirty or broken emitters. Verify that irrigation system pressure is within manufacturer specifications. Make sure replacement emitters match existing equipment.

10.4.3.2 Monitoring Equipment

Beyond irrigation timers, Fort Hood requires the use of a soil tensiometer or other sensor to determine when the soil is dry and gauge the amount of water needed. If using a variety of automatic controls, all controls must have a functioning manual override feature. Rain sensors also can be installed to shut off automated irrigations systems when it is raining. Consider installing an irrigation meter to measure the amount of water applied to the landscape. Make sure all handheld hoses have shut-off nozzles.

10.5 LANDSCAPE DESIGN GUIDELINES

The visual impressions that exist within the installation form the installation's image. The primary locations of highly visible images occur at the main gate, along primary circulation systems, and at areas of high concentrations of people. Site features such as signs, statuary, static displays, and other primary visual images can be enhanced by the use of trees, shrubs, and groundcover. The following sub-sections discuss landscape enhancements for:

- Energy efficiency;
- General conditions;
- General areas that are not defined by or transcend visual zones; and
- Visual zones as identified in Section 5.

10.5.1 Energy Efficiency

The climate immediately surrounding a building is referred to as its microclimate. Plants can be used in several ways to further enhance microclimatic conditions. Trees, shrubs, vines, and groundcover plants can provide shade, windbreaks, and wind channels. For example, to block solar heat in the summer but let much of it in during the winter, use those deciduous trees referenced within the Plant Palette, Appendix I. To provide continuous shade or to block heavy winds, use those evergreen trees or shrubs referenced within the Plant Palette. Climate-appropriate landscape enhancements offer substantial environmental benefits, including reduced

- Carefully positioned trees can save up to 25% of a building's energy consumption for heating and cooling. On average, a well-designed landscape provides enough building energy savings for a return on the initial investment in less than eight years.
- In the summer, shading and evapotranspiration (the process by which a plant actively moves and releases water vapor) from trees can reduce surrounding air temperatures as much as 9 degrees Fahrenheit (°F).
- Studies by the Lawrence Berkeley Laboratory found summer daytime air temperatures to be 3°F to 6°F cooler in tree-shaded neighborhoods than in treeless areas.
- Buildings with winter windbreaks placed only on the windward side (the side from which the wind is coming) averaged 25% less fuel consumption than similar but unprotected buildings.

summer and winter energy demand loads. The following discussions illustrate ways in which landscape enhancements can be used to reduce energy demand.

Photo: Warren Gretz, ©DOE/NREL, n.d.

Shade from trees is a simple but effective strategy for reducing costly cooling requirements. This photograph shows how trees minimize heat gain in the building and surrounding concrete.

10.5.1.1 Trees

Trees are the primary plant in an energy-conserving landscape. Shading is the most cost-effective way to reduce solar heat gain and cut air-conditioning costs. Effective use of shade requires knowledge of the size, shape, and location of the moving shadow that the shading device casts. Trees can have a canopy large enough to shade roofs, reducing cooling costs and increasing comfort. Deciduous trees with high, spreading crowns (i.e., leaves and branches) can be planted on the south and east sides of a building to reduce solar exposure. When trees drop their leaves in the winter, sunlight can penetrate the building and help to heat it. It should be noted, however, that even without leaves, trees can block as much as 60% of the sun from the building, making appropriate plant selection and their placement critical to effectiveness. Trees with crowns lower to the ground are more appropriate to the west, where shade is needed from lower afternoon sun angles.

A tree that will reach a medium to large size, such as a big-tooth maple or Texas white ash, should be located at least 20 feet from the side of a building and 12 to 15 feet from the corner. Smaller trees can be planted closer to a building to shade walls and windows. A 6-foot to 8-foot (1.8-meter to 2.4-meter) deciduous tree planted adjacent to a building will begin shading windows the first year. Depending on the species and the building's height, the tree will potentially begin shading the roof in five to ten years.

Properly selected and placed landscaping can provide excellent wind protection and wind channeling benefits that can reduce winter heating and summer cooling costs considerably. As trees and shrubs mature, these benefits will increase. For maximum protection, plant a windbreak at a distance from the building of two to five times the mature height of the trees. A 25-foot-tall windbreak should be placed 50 to 125 feet from a building. For a windbreak to be effective, it must extend to the ground. The best windbreaks block wind close to the ground by using trees and shrubs with low crowns. The foliage density on the windward side should optimally be around 60 percent. Two to three rows of

evergreen trees in staggered order should be used. If using deciduous trees, plant five to six rows. The length of a windbreak should be 11.5 times the mature width of the stand of trees. The tree heights within the windbreak should be varied.

Evergreen trees and shrubs planted to the north and northwest of a building are the most common type of windbreak. Evergreen trees combined with a wall, fence, or earthen berm can deflect or lift the wind over a building. Avoid planting evergreen plants too close to a building's south side if warmth from the winter sun is desired.

10.5.1.2 Small Trees / Shrubs

Small trees and shrubs will be used to shade split air conditioning or heat pump equipment located outside a building. This will improve the performance of the equipment and can increase efficiency by as much as 10%, as well as screen unsightly views of the equipment. For good airflow and access, plants will not be closer than 3 feet to the compressor. Evergreen shrubs and small trees can be planted as a solid wall at least 4 to 5 feet away from the north side and provide a windbreak. Planting shrubs, bushes, and vines next to the building can create dead air spaces that insulate a building in both winter and summer; however, it is better to have dense plantings further away so air movement can occur during the summer.

10.5.1.3 Vines and Landscape Structures

When trees are young and not providing much shade, vines can be used to provide shading on walls and windows. Vines that lose foliage in the winter can be used for summer shading as long as vine stems do not significantly block winter sun. Evergreen vines will shade walls in the summer and reduce the effects of cold winds in the winter. When combined with vines and other trained vegetation, landscape structures such as arbors, trellises, and pergolas adjacent to buildings, will reduce temperatures as air movement passes through the structure and is cooled by evaporation at the plant's leaves. The shade created by the landscape structure is also beneficial. Avoid using climbing vines directly on building walls, as these create runways for rodents and harborage for undesired bird species along with many insect pests. Instead, use trellises, placed close to the walls, to support vine growth without touching the walls.

10.5.1.4 Groundcover and Grasses

Certain grasses, such as buffalo grass and fescue, grow only to approximately 6 inches (15 centimeters) and are water thrifty. By using these species, the fuel, water, time consumption, and air pollution associated with lawn mowing, watering, and trimming can be eliminated.

Groundcover and grasses also have a cooling effect as a result of evapotranspiration. The temperature above a groundcover will be 10 to 15 degrees cooler than above a heat-absorbent material such as asphalt or a reflective material such as light-colored gravel or rock. A heat absorbent material like asphalt also will continue to radiate heat after the sun has set. Minimize the use of heat-absorbent and reflective materials near a building and/or shade them from any direct sun.

10.5.2 General Conditions

10.5.2.1 Streetscape Design

Street trees and other repetitive elements can provide rhythm and continuity.

Most of the streets and roads on the installation pass through areas that are fully developed and well-maintained. The landscape materials and planting areas should be proportional in scale to the hierarchy of the street on which they are located. Streetscape and pedestrian improvements adjacent to these streets typically consist of curbs and gutters, sidewalks where there is pedestrian traffic, and some degree of ornamental planting, typically trees, of varying species. Street tree plantings will be used to reinforce vehicular hierarchy, orient and direct traffic, upgrade views, and to visually de-emphasize on-street parking. As a general rule, street trees should be deciduous species, resistant to root pressure, and should have a 10- to 12-foot clearance between the street pavement and lower branch height to allow adequate clearance for pedestrian and vehicle traffic to pass unimpeded. Also during the selection of street trees, consideration must be given to the potential interaction of the tree with overhead utilities and the maintenance and overall look of the tree if future pruning is necessary. In the design of a street tree planting, different plant species may be used to identify distinctive details or areas of the installation, for example, a particular land use relationship, historical district, community area, or other similar entity.

It is important to have contrasting landscapes, depicting varying degrees of refinement and formality. For primary circulation corridors, a formal planting design is required. For the Hood Road corridor, single allees of Plateau live oaks are recommended, planted 30 feet on center. Additional streets that should receive formal streetscape enhancements include Central Avenue, the south side of Hell on Wheels Avenue, Tank Destroyer Boulevard, east of 72nd Street, and Battalion Avenue. Tertiary north-

south cross streets running through the Troop Housing Visual Zone and streets within the Family Housing Visual Zone should also receive a formal street tree planting treatment. In the case of the latter examples, deciduous trees such as big-tooth maple and Texas white ash are recommended to be planted, conforming to a regular spacing pattern (30 feet on center). A uniform application will aid in shading street pavement and defining a particular district. For example, regular street tree plantings within the Family Housing Visual Zone will provide a sense of continuity to a neighborhood area, as the individual yards will otherwise be planted according individual homeowner preferences. The street tree layout should be coordinated with the layout of proposed street lighting. By contrast, more naturalistic landscape enhancements are recommended for secondary entrance corridors like the Clear Creek Road Corridor (PIP No. 2) and Fort Hood Street Corridor (PIP No. 3 [see Section 6]). In these areas, trees such as Plateau live oak, Texas pistache, prairie flame sumac, and yaupon holly can be informally planted, individually and in large groves, replicating how the plants might be found in a natural setting.

10.5.2.2 Parking Lots

Parking lots are often the least attractive elements on a military installation. The use of landscape plant material can greatly improve the appearance of these areas, as well as help define circulation and reduce heat gain during summer months. All parking lots will be designed for LID management features.

Locate trees to break up and shade expanses of paving, and to create a canopy effect.

Parking lots should be designed to have islands within the parking lot, where trees can be planted. When selecting trees for parking lots, use rounded, high-branched, dense, and relatively fast growing trees. Additionally, select trees that can withstand harsher conditions such as sun, glare, heat, and reduced water supply. Avoid trees with low-growing branches. Trees planted in a parking lot must have a minimum 12-foot clearance from ground to canopy bottom. Choose trees and shrubs that require minimum maintenance and will not litter the parking area with branches, fruit, or nuts. The Texas white ash is recommended for use in planting islands.

Planting peninsulas should separate entrances from parking spaces. Locate trees to break up and shade expanses of paving and to create a canopy effect. The optimum spacing of parking lot shade trees is 30 to 40 feet on center. Maximum spacing should be one tree for every six to eight parking spaces. Consider sight distances near entrances and exits when selecting and placing plant material. Set trees 3 to 6 feet (1 to 2 meters) from the backs of curbs. Spacing should be uniform, except where curb cuts interrupt regular spacing.

Where feasible, in sloped parking lots, parking islands should run perpendicular to the slope. Curbs around islands should have breaks on the up-hill side of the island, where stormwater sheet flow can penetrate the island and infiltrate the soil. In this case, the planting areas within islands should be depressed below the finish grade of the parking lot, sloping up to the inside of the curbs. This configuration, along with pervious paving, will allow stormwater to infiltrate the ground and replenish the groundwater table, as well as enable trees to access and absorb stormwater runoff (also see Section 9.9).

Parking lots should be designed to have islands where trees can be planted within the parking lot.

10.5.2.3 Natural Areas

When restoring disturbed areas back to a natural condition or when stabilizing a construction site that does not have an established planting plan, refer to the Vegetation Establishment section in the Fort Hood Construction Criteria (Section 13). When revegetating areas to function as a natural plant community, all areas of disturbed ground must be seeded. Fort Hood requires the use of only native grass species for seeding (see Appendix I). Coordinate work with the Fort Hood Natural Resources Management Branch Agronomist to ensure that the planting design responds to landscape ecological principles pertaining to the development of forest patches, coved and lobed vegetative edges, boundaries with high structural diversity, and landscape corridors that provide connectivity to adjacent landscape features.

Landscape planting of small trees and/or large shrubs should be used to supplement screening of dumpsters and other unsightly utilities.

10.5.2.4 Screening

Landscape planting should be used to supplement wood fence and masonry walls to screen dumpster enclosures, utilities, etc. Plants combined with berms make attractive and effective screens. Fences and walls also can be used (see Sections 11 [for design] and 12 [for protection]).

10.5.2.5 Foundation Planting

Foundation planting provides a green background for additional plantings, adds scale and character to the building, helps integrate the building with its surroundings, screens HVAC and other utilities, and helps create a sense of arrival. When developing foundation planting plans, consideration should be given to force protection measures (see Section 12).

- Focal and seasonal plantings should be located at building entries for pedestrian interest.
- Use the building's architecture to evaluate the planting design and selection of plants.
- Plant materials should not block windows and views from interior spaces.
- Trees should be set back from the building walls to provide space for mature growth and to prevent root systems from damaging the foundation.
- A symmetrical foundation planting design should be used for a symmetrical building.
- Due to the possibility of insect problems (bee stings, etc.), do not plant flowering plants that will attract threatening insect species near entrances.

10.5.2.6 Removal of Debris from Land Disturbance

All land-clearing debris shall be taken to the Fort Hood Compost Center. On a case-by-case basis, alternate sites can be chosen. Contact DPW-Environmental Division for a list of these sites. Also see Section 13.3.1.

10.5.3 General Areas

10.5.3.1 Cantonment and North and West Fort Hood Perimeters

The predominant areas of natural vegetation viewed by most people occur around the perimeter of Fort Hood. Along the boundary of the installation, vegetation associated with native Texas Prairie plant communities should be established and strengthened (see Appendix I, Approved Plant List for Landscaping on Fort Hood). Random and informal groupings of large trees such as big-tooth maple, cedar elm, and pecan should be planted for colorful fall display. An informal, naturalistic setting will provide a contrast to a more formal enhancement program at the primary and secondary entrances to the installation.

10.5.3.2 Cantonment Interior

Within the Cantonment area, establish a formal, cruciform development pattern, maintaining Hood Road as the central spine, connecting cross streets, and culminating with Hell on Wheels Avenue as the northern separation between internal Cantonment administrative and community activities and mission support-related land uses (motor pools, airfields, etc.).

Within the Cantonment, natural drainage patterns, allees of trees, gateways and entrance features will be used to define visual zones and create a network of pedestrian greenway corridors, connecting residential areas with institutional, recreational, and commercial centers (see Section 6, PIP No. 23). Lands within the Cantonment will be fully utilized, either for future infill development or for preservation as open space.

10.5.3.3 Installation Entrances

The entrances and streetscapes leading into the installation are areas where landscape treatment should provide a strong visual image interest during all four seasons. Low shrubs, groundcover, annual/perennial plants, and canopy trees provide seasonal interest and maintain views required to ensure force protection measures. Large evergreen trees are discouraged in these locations because they may obstruct sightlines and impact the need for force protection. Adequate lines of sight must be maintained for guard personnel to observe vehicular and pedestrian traffic approaching the gate. Proposed landscaping must be integrated with the force protection requirements of Section 12.3.7.

Landscape enhancements around access control points must be integrated with force protection requirements.

10.5.4 Visual Zones, Landscape Standards and Criteria

The standards and criteria defined below are based on the future visual zones developed for Fort Hood (see Section 5).

With the Airfield visual Zone, landscape enhancements will be directed at plantings that serve to reduce solar exposure and the radiant energy that buildings receive.

10.5.4.1 Airfield Visual Zone

The built environment of the two airfields is dictated solely by function. The landscape is open with large expanses of pavement and grass fields periodically interrupted by clusters of buildings, primarily hangers and administrative buildings. Landscape enhancements will be directed toward plantings that can reduce the amount of solar exposure and radiant energy buildings receive, can reduce the heat island effect, and can provide functional outdoor space with comfortable climatic exposures (e.g., shaded areas and associated site furnishings) for the users/workers of the airfields.

Trees should be selected that provide dense shade and minimal amount of litter.

Upright, high-branched trees, such as the Texas white ash, planted along the southern façades of buildings can serve to cool the buildings during the summer, while allowing solar penetration during the winter. The perimeters of the airfields should be managed to encourage a buffer of native Texas plant communities that can reduce noise. Trees and shrubs should be planted in informal groupings. For this less formal zone, plant material and the use of turf will be selected for its low-maintenance characteristics.

10.5.4.2 Troop Housing and Support Visual Zone

The principal landscape enhancement objectives within the Troop Housing Visual Zone include: 1) increase the level of continuity through a reduction in types of materials used; and 2) develop comfortable outdoor spaces within which to relax, gather, and recreate. In general, the exterior spaces around much of the older troop housing, located between Central Avenue and Old Ironsides Avenue are suffering from an accumulation of ad hoc landscape treatments, resulting in miscellaneous applications of a wide range of landscape construction materials, serving duplicative purposes. In addition, the degree to which the landscape materials are maintained varies throughout the area.

- For this zone, trees should be selected that are upward-branching, and that provide dense shade and a minimal amount of litter. Trees should be arranged to form either formal, orthogonal blocks (bosques), or informal groves. Bosques or groves should be located to respect and enhance existing site geometries and axes, including arrangements of buildings, building openings, and circulation networks. The ground plane beneath bosques and groves can be grass or hardscape, as long as the area is adequate for trees to receive stormwater runoff.

- High priority areas, such as battalions and company headquarters buildings, may have formal plantings schemes.

- Less formal areas of this zone will be comprised of turf and other plant materials selected for their low-maintenance characteristics.

- Pedestrian circulation should adhere to the objectives outlined within Section 9.12 of the IDG. Where possible, planting beds should be defined by sidewalks. Landscape furnishings (see Section 11) such as benches and picnic tables should be located so they take full advantage of available shade. Furnishings, such as bicycle racks, should be consolidated into one area and secured on a concrete apron. Bike racks and other furnishings, such as street and landscape lighting, bollards and waste receptacles, should be uniform in finish and color and bear some relationship to adjacent building finishes and features.

Multiple types of edging and retaining wall materials are available.

Several beds containing weeds and gravel groundcover of varying aggregate, textures, and colors, as well as disparate plantings of overly-pruned shrubs – remnants of formal massing configurations.

Narrow sidewalks of poor construction and finish meander around buildings.

Sucker growth at the bases of existing trees should be removed.

10.5.4.3 Maintenance and Warehouse Visual Zone

Plantings can reduce the amount of solar exposure and radiant energy that buildings receive.

The Maintenance and Warehousing Visual Zone consists of two principal districts within the Main Cantonment area, the motor pool area, north of Hell on Wheels Avenue and the 13th Corps Support Command (13th COSCOM) area west off the intersection of Tank Destroyer and 72nd Street. For the north area, no landscape-related recommendations will be made for obscuring the view of the motor pool areas north of Hell on Wheels Avenue. These motor pools project the military force of Fort Hood's mission.

Perimeter landscape standards for the 13th COSCOM area (as well as North and West Fort Hood Maintenance and Warehouse Zones) will be compatible with and enhance adjacent visual zones' landscape and streetscape initiatives. Within this visual zone, plantings will be designed to reduce the amount of solar exposure and radiant energy buildings receive, to reduce the heat island effect, and to provide functional outdoor space with comfortable climatic exposures (e.g., shaded areas and associated site furnishings) for the users/workers of this zone.

10.5.4.4 Rangeland Visual Zone

Landscape enhancements within the Rangeland Visual Zone will focus in part on ecological protection, restoration, and stabilization.

Landscape enhancements within the Rangeland Visual Zone will focus on:

- Ecological protection, restoration and stabilization (see below);
- Plantings of Texas white ash and cedar elm around the range control and instruction buildings to reduce the amount of solar exposure and radiant energy buildings receive; and
- Plantings to provide functional outdoor space with comfortable climatic exposures (e.g., shaded areas and associated site furnishings) for the users/workers.

Ecological Protection, Restoration, and Stabilization

Protecting, maintaining, and enhancing vegetative riparian buffers through landscape practices is crucial to the water quality protection of Fort Hood's streams and drainage corridors. These buffers can reduce harmful effects of landscape disturbance and provide important habitat for birds and

Courtesy of the Center for Watershed

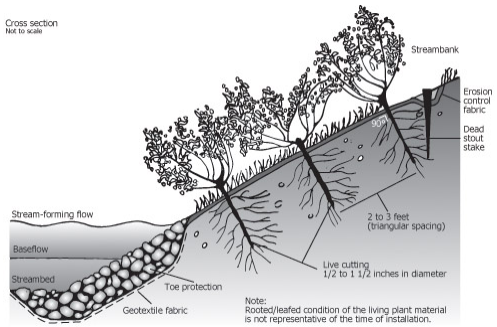
Vegetated buffers filter pollutants and slow stormwater runoff before it enters waterways.

animals, as well as shade for fish. The two primary land-disturbance activities are training and cattle grazing. All training operations and grazing should remain outside riparian buffers with a minimum buffer/setback width of 50 to 100 feet on either side of the stream.

In riparian buffer areas, trees and woody shrubs should be used to establish barriers and provide soil stabilization. Trees and woody shrubs are preferred over grass only because they have a deeper and more extensive root system that intertwines. One method of establishing a visible and impenetrable barrier into a riparian buffer is to plant a thick screen of understory, evergreen plant material, such as yaupon holly, several feet thick. Other planting methods to help achieve protection and stabilization are often referred to as bioengineering techniques. These methods use live woody vegetation (e.g., black willow). Installed along stream banks, bioengineering techniques can provide erosion protection and reinforcement of adjacent soils, and in time, can produce a woody vegetative surface cover and protective root network. Using these techniques can also provide a natural appearance and improved wildlife habitat.

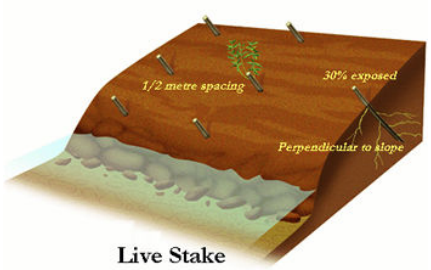
The following bioengineering techniques should be used for embankment stabilization within the Rangelands Visual Zone:

- **Live stakes or cuttings.** Live stakes are living, dormant, woody plant cuttings capable of quickly rooting into the stream bank. Stakes are 1 to 2 inches in diameter and cuttings are finger-sized. Both stakes and cuttings are installed in winter, when the plants are dormant, and grow into mature shrubs that stabilize the stream bank. Stakes and cuttings are most effective in stabilizing banks of moderate slope (2:1 or less) and should be placed on original bank soil. Because they are not effective until top growth has occurred they are best used in conjunction with other natural or structural erosion control methods. Staking and cuttings also can be a great proactive method for increasing vegetative cover along a stream where existing vegetation is sparse.



Courtesy of the Virginia cooperative Extension Service

Live Staking Installation Detail – Cross Section.

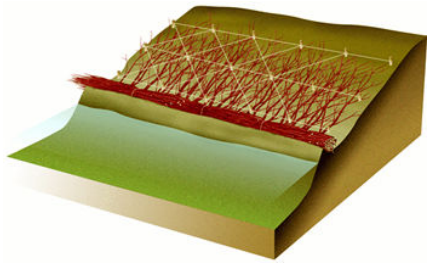


Live stakes spacing pattern.

Live staking recently installed along stream bank.

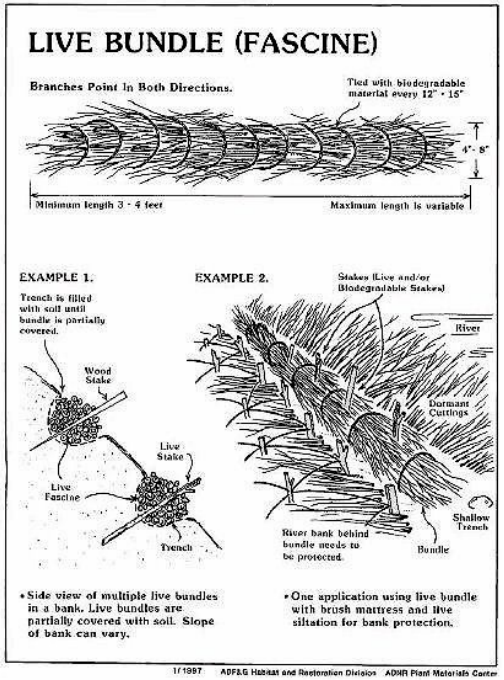
Fascine bundles ready to be installed.

- **Brush rolls**. Brush rolls are large (24 inches in diameter) bundles of any type of brush. Placed parallel to the stream flow and staked into the bank as low as possible, these rolls can deflect water away from the bank and collect sediment, forming a shelf at the toe of the stream bank. Brush rolls can also be planted with live plant material before or after installation. The best time to install brush or fiber rolls is during low water flow, anytime during the year. Brush rolls are inexpensive and have proven to be effective on steep banks, where there is little room to work.



Fascine Bundles Installation Diagram

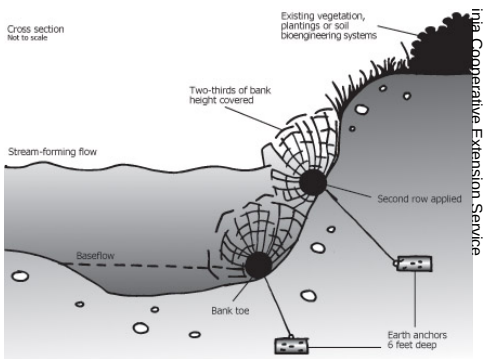
- **Live fascines**. Like brush rolls, live fascines are sausage-like bundles of live, woody cuttings, tied together. Fascine bundles are placed in shallow ditches cut longitudinally into the stream bank and secured with live or dead stakes. After installation, fascines will sprout to produce a thick cover of brush. Fascines can be used on streams of all sizes and character and will protect banks from washout and seepage. Fascine installation is best performed during winter months, when the vegetation is dormant. Live fascines are an effective and immediate stabilization technique once rooting is established.



laska Dept. of Fish and Game

Fascine Bundle Installation Detail

- **Tree revetments**. Tree revetments use densely branched softwood trees, or tops, 6 to 12 inches caliper. Cedar, spruce, and fir (Christmas trees) work well. The trees are anchored to the toe of the bank in an overlapping, horizontal pattern with the trunks facing upstream. Higher banks may need two or more horizontal layers of revetment. The trunks are cabled to duckbill anchors driven into the bank. The trees deflect the current from the bank and trap sediment in their needled branches, which forms a shelf for planting and catches slumping bank material from above. Fascines and live stakes can be planted in the entrapped sediments to re-vegetate the upper portions of these sites. Tree revetments should be installed in the fall or winter, so their needles do not fall off before they have a chance to catch and hold sediment. Revetments have a good record of reforming a river's channel and improving fish habitat.



nia Cooperative Extension Service

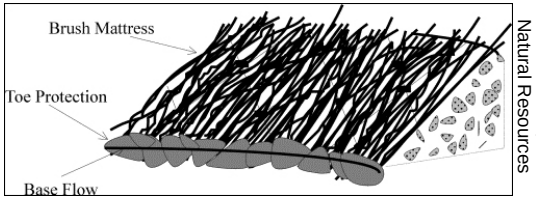
Tree Revetment Installation Diagram

Courtesy of Wisconsin Dept. of Natural Resources

Brush mattress installation along stream bank.

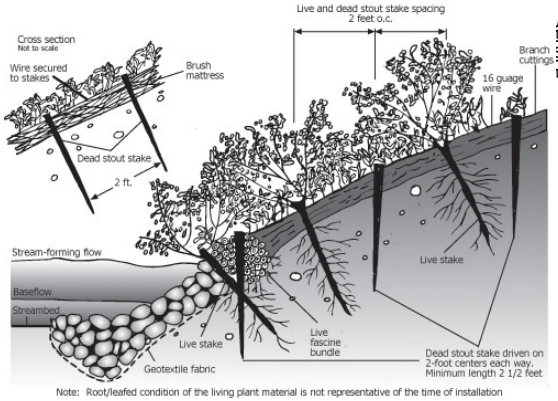
- **Brush mattresses**. A brush mattress is a combination of living units: live stakes, fascines, and a mattress branch cover of live and/or dead material. A brush mattress forms an immediate, protective surface cover on the stream bank. Brush mattress systems are intended to root and grow, while the mattress itself slows water at the bank surface. This method is particularly successful for washed out banks. Mattress should be installed in winter, when plants are dormant.

For additional information on management of vegetation and lands within the Rangelands Visual Zone, refer to the forthcoming Fort Hood Natural Resources Division's Integrated Natural Resource Management Plan (POC #254 288-3211).



Courtesy of Wisconsin Dept. of Natural Resources

Brush Mattress Layout Diagram



Courtesy of Virginia Cooperative Extension Service

Brush Mattress Installation Diagram

10.5.4.5 Recreation / Open Space

- **Parks and Open Space**. Shaded areas should be provided adjacent to playgrounds and other areas of active recreation. Informal groupings of Plateau live oak should be planted within shallow, micro-detention basins. Understory trees, such as desert willow and Texas redbud should be planted along pedestrian circulation corridors. Understory massings of evergreen sumac should be used to screen utilities, but not so densely as to create poor visibility, hiding places, or unsafe areas. Plants with thorns should be avoided, especially where children play.

- **Green Buffer**. All areas that maintain a green, open-space buffer, especially along drainage ways, should be planted with native plant species of varying sizes to reinforce Texas Prairie plant communities and provide new habitat areas for wildlife. In buffer zones that contain recreational trails, plant material should be maintained to provide visibility (see Section 10.5.2.3, *Natural Areas*).

Shaded areas should be provided adjacent to playgrounds and other areas of active recreation.

Unify neighborhoods through street tree planting.

10.5.4.6 Family Housing Visual Zone

A unique planting design should be developed for each family housing neighborhood. Unify neighborhoods through street tree planting. Front yard landscapes should be designed to include street trees such as big-tooth maple, cedar elm, and Texas white ash. Street trees should be planted a maximum of 10 feet from the edge of the street. Planting areas shared by two homeowners should be coordinated to achieve a unified design.

10.6 ANTI-TERRORISM / FORCE PROTECTION LANDSCAPE CONSIDERATIONS

Landscape design shall comply with force protection requirements and shall be used to enhance the overall attractiveness of security elements. The designer responsible for the placement of landscape elements is required to work closely with the force protection experts at Fort Hood. All proposed landscape material and plans must be reviewed for compliance with force protection. Refer to Section 12 for a discussion on the applicability and use of landscape and site furnishing for force protection.

10.7 PLANT MATERIAL SELECTION

This IDG provides direction for all units, directorates, and family housing on Fort Hood to meet the need for a project landscape plan, an excavation permit (FH 200-X10), planting techniques, and a long-term maintenance schedule. Plants and turfs identified in this IDG are considered suitable for the local climate and are the only plants that should be used in Fort Hood landscaping. These plants are native to the region, adjust well to seasonal rainfall patterns, and minimize the need for maintenance.

For additional information related to plant material selection, an excavation permit (FH 200-X10) for landscaping, landscape plan approval, and a long-term maintenance schedule contact the Fort Hood Agronomist (254 288-3211). All landscape plans are required and must be approved by the Agronomist.

Trees, shrubs, groundcover, and turf are the major elements of a planting composition. Basic plant selection criteria should consider the following:

- **Compositional Considerations**. The selection and composition of a planting design requires an understanding of each plant's characteristics, form, and environmental needs as well as how each plant can relate to and complement other plants in the design. A unified, sustainable

composition can be created through utilizing native materials for low maintenance and minimal water requirements, avoiding incompatible colors, textures and forms, and matching the appropriate plant to the land use, situation, and environmental condition.

- **Growth Characteristics**. Although a slow-growing tree may require many years of growth before it shades your roof, it will generally live longer than a fast-growing tree. Also, because slow-growing trees often have deeper roots and stronger branches, they are less prone to breakage by windstorms or heavy snow loads. And they can be more drought resistant than fast-growing trees. Consider growth rate, strength, and brittleness when locating trees near walkways or structures. Ask whether the mature tree's root system is likely to damage sidewalks, foundations, or sewer lines. The smaller the area, the more important it is to select a tree with manageable roots.

- **Shape Characteristics**. The density of a tree's leaves or needles is important to consider. Dense evergreens, like spruces, make great windbreaks for winter winds. If you are just looking to impede summer winds, choose a tree or shrub with more open branches and leaves. Such trees are also good for filtering morning sun from the east, while denser trees are better for blocking harsh afternoon summer sun.

- **Hardiness**. The ability of plant material to provide lasting benefit is dependent upon the plant's hardiness and its appropriateness to the site use. Major factors affecting plant hardiness are soil type and organic content, temperature, moisture, and light. These climatic conditions can be modified to an extent by specific site conditions such as wind protection, solar orientation, and planting design to create microclimates.

10.8 PLANT CATEGORIES AND PLANT PALETTE

The plant list for landscaping on Fort Hood (Appendix I) and the plant categories are intended to help the designer choose the best plant for each particular set of design requirements. The selected plants were chosen for their hardiness and their ability to survive in the geographical area of Fort Hood. To use them effectively, the design's programmatic requirements must be appropriate and well defined for the specific site.

- A select group of plant materials has been divided into the following nine categories:

- Large trees;
- Small trees;
- Tall shrubs;
- Low shrubs;
- Vines;
- Xerophytes;
- Perennial flowers;
- Ornamental (tall) grasses; and
- Turf grasses.

Within the plant list, plants appear in alphabetical order by their common name, followed by their botanical name, design characteristics, and cultural information. Plants are cataloged according to similar plant characteristics. These characteristics pertain to the plant's form and growth rate, including a) environmental characteristics, related to the plant's tolerance to conditions of sun and shade, as well as moisture regime requirements; b) ornamental characteristics, pertaining to seasonal interest, floral, and other unique characteristics of interest; or c) functional characteristics, regarding the plant's utility to accommodate particular plant requirements.

For additional information on regionally appropriate plants and their maintenance requirements, contact the Fort Hood Agronomist, the Coryell County Extension Service, public libraries, local nurseries, landscape architects, landscape contractors, and state and local energy offices. The approved plant list is presented in a matrix format in Appendix I of this IDG.

10.9 PLANT MATERIAL INSTALLATION

When planting trees, shrubs, hedges, or bushes, find out how large the mature specimen will grow. In all cases, determine spacing by the *mature* sizes. Consider future plant size in relation to conflict with sidewalks, drives, buildings, streets, and overhead utility lines. For those plants close to a building,

plan for at least 1 foot (30 centimeters) of extra clearance between the full-grown shrub and the wall of the building. This will prevent heavy pruning or damage to building siding in the future.

10.9.1 Inspection of Plant Material

A key step in assuring successful planting is to select plants of the highest quality. Plant material should be of the size, genus, species, and variety to comply with the recommendations and requirements of the *American Standard for Nursery Stock,* ANSI Z60.1. As part of the design process and prior to plant installation, review the installation's master plans, basic information maps, or as-built drawings for utility locations and verify with the DPW or equivalent, TM 5-803-13, *Landscape Design and Planting Criteria*, Chapter 3, “Planting and Establishment of Trees, Shrubs, Ground Covers and Vines.” Specify larger trees at planting for a more immediate effect. Large trees should be ordered no larger than 3 to 3.5-inch caliper, measured from the base of the trunk. Reject any plant material that does not arrive to the site in a healthy condition or that differs in size, age, or species from what is ordered. Large plants cut back to the appropriate size should not be accepted. The form should be characteristic of that species, and the plant should have a well-developed branching habit. Avoid buying damaged specimens. Thoroughly inspect the bark, limbs, and roots to make sure the plant was handled carefully during growing, digging, and shipping. All plant material should be inspected for insects and disease. Inspect plant leaves for fungi and the base of trunks for borers. Reject plant stock with signs of insects or disease (cocoons, egg masses, cankers, or lesions).

After purchasing the plants, be sure to keep tiny root hairs damp and shaded at all times. The plants will not survive if these root hairs are allowed to dry before planting. Balled and burlapped plant material should have a solid root ball of earth held in place securely by burlap and stout ropes. The size of a tree’s rootball equates to the tree’s caliper, whereby, for every inch in caliper, there should be a minimum of 10 inches of rootball diameter, plus the full caliper of the tree. For example, a 3.5-inch caliper tree should have a 33-inch diameter rootball. Container-grown stock should not be root bound. Plants that are unusually large for their containers, are leggy, and/or that have numerous dead foliage should be rejected.

10.9.2 Installation of Plant Material

The following actions/techniques are required during plant installation:

1. Locate and mark planting sites and apply for an approved excavation permit (FH 200-X10). A permit is required prior or any digging on Fort Hood and is necessary to prevent damage to the underground utility systems.

2. Locate and dig a hole that is two to three times the diameter of the container and no deeper than the container. Keep all original topsoil for backfilling. Be certain that the hole has rough and uneven edges and is irregular in size, as this will encourage the new roots to spread and not become root-bound within the hole. Plant only as deep as the level of dirt in the original pot; planting too deeply may kill the plant.

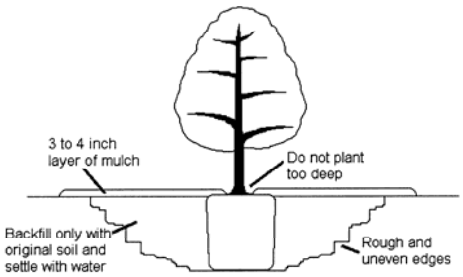
3. Always handle plants by the container or ball, never by the stems, as this will damage the plant. If the plant is root-bound, make two cuts across the bottom layer of roots and several cuts along the sides to loosen the roots.

4. Set the plant in the hole vertically and remove the container. If the plant is balled and burlapped, remove the wire basket, unpin and fold back the burlap. Backfill only with the original soil. Do not backfill with compost, peat moss, or other materials. Add one third of backfill soil at a time; tamp very lightly to settle the soil and help secure the plant. Repeat this process until the hole is full and thoroughly watered.

5. If desired, edging may be installed. Metal edging is preferred; install the edging 4 inches below the surface and 2 inches above to help keep grass from invading into the planting area.

6. Place a 3- to 4-inch-thick layer of mulch around all plants to keep them free of weeds and grass. Use only shredded hardwood mulch, hardwood chips, or cedar mulch. Do not use pine bark mulch. Do not use rock of any type instead of mulch. For planting beds, mulch the entire bed. For individual plantings of trees of shrubs, mulch 2 to 3 feet around the trunk in every direction.

7. Do not use tree stakes or guy wires of any kind as these actually weaken trees. The only exception to this no-staking rule is for very large (greater than a 4-inch trunk), balled, and burlapped trees. These trees may be staked for a period not to exceed two years, after which



Tree Installation Detail

time, all stakes and guy wires must be removed. Do not wrap any material around the base of the trunk. Such wrapping encourages problems related to insects and diseases. Do not prune trees and shrubs at planting time. Do not paint trees.

8. Install a saucer around the plant after it has been backfilled and planted. To create a saucer, form a small, circular, earthen berm, or saucer, around the plant. The diameter of the saucer should correspond to the plant's canopy. The saucer will help to contain water immediately after planting. Saucers are not necessary for shrubs planted in a mulched bed. When planting vegetation on a slope, form the saucer so that the uphill side of the saucer is open, at grade with the existing topography. This will enable the plant to receive sheet drainage that is captured in the saucer. Additional information regarding the planting and establishment of trees, shrubs, groundcovers, and vines is detailed in TM 5-803-13, Chapter 3.

9. Do not plant trees and shrubs without a commitment to care for them. Water all plants thoroughly during the first 24-hour period after planting. Continue watering trees and shrubs when rainfall is not sufficient. A rain of at least 1 inch per week is sufficient. When rainfall is less than 1 inch, each tree and shrub will need to be watered once per week during the summer months and every other week during the fall, winter, and spring months for one to two years. A slow trickle of water from a water hose for one hour is the preferred method of watering. Sprinkling, especially during the summer months, is wasteful; more water is lost to evaporation than soaking into the soil (also see Section 10.4.3).

10.9.3 Installation of Planting Beds

Keep the landscape soil line 2 to 3 inches below the slab line of the structure to prevent moisture and pest entry. Install a 2- to 3-foot gravel barrier, approximately 6 inches deep between the exterior wall and planting bed to prevent rodent burrowing. This allows access for pest surveillance, while providing a pathway for use of a chemical barrier, if treatment is needed.

It is recommended that landscape fabric is installed prior to the placement of groundcover. Place the fabric beneath edging so that it covers the entire surface of the bed. Use a fabric that restricts weeds, but that allows air and water to penetrate; do NOT use a solid plastic film.

Source: Kansas State University.

Buffalo Grass is a native, drought-tolerant grass that should be used as turf for non-shady lawns.

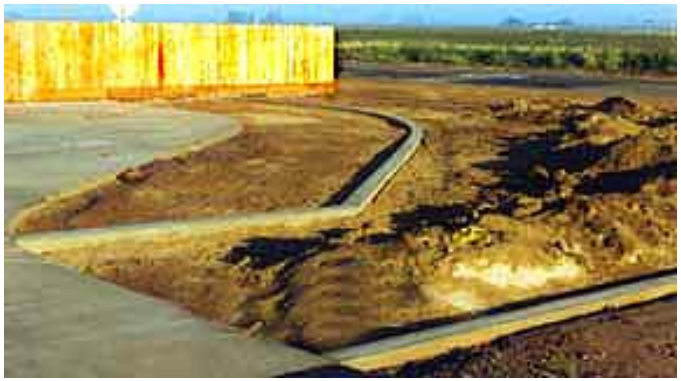
10.9.4 Installation of Lawn Areas

Installation techniques for turf are detailed in TM 5-803-13, Chapter 4, *Establishment of Turf*. The details include site evaluation, site preparation, selection of turf, and maintenance requirements.

To keep maintenance requirements low, planting turf grass should be kept to a minimum (refer to Appendix I for approved turfs). The native, drought-tolerant, buffalo grass should first be considered for use at Fort Hood, provided that the planting conditions are suitable for the species. When the landscaping goal is for a more formal appearance, incorporate a less drought-tolerant turf such as Bermuda grass. In all cases, Fort Hood is committed to minimizing the overall turf area by incorporating native shrubs and plants and avoiding planting turf in long strips. Irrigating and maintenance will have greater efficiency when turf is planted in rounded, compact shapes.

To the greatest extent possible, eliminate narrow strips of grass. Small strips of grass, common in parking islands and between sidewalks and the roadway are hard to maintain and difficult to efficiently water. Use bushes instead. If grass strips must be used, they should be planted with Buffalo grass. During routine mowing cycles, alternate turf mowing height between low and high levels. This encourages roots to grow deeply so plants can tolerate longer periods between watering.

Where lawn areas abut the bases of walls, consider a concrete mow curb, a minimum of 12 inches wide and 6 inches deep. The top of the mow strip should be 2 inches above finish grade elevation. Where planting beds are adjacent to sidewalks or curbs, the sidewalks and curbs should be used as the principal bed edge.



Concrete mow curb installed prior to laying sod.

10.9.5 Scheduling of Plant Material Installation

To ensure the likelihood of plant survival, the following basic planting schedule designed for the Fort Hood climate will be followed (Table 10-3). Time of planting and the party responsible for ensuring that planting occurs and is maintained will be identified for each project involving landscaping. This will improve the planting success and decrease tree and plant mortality.

Table 10-3 Fort Hood Planting Calendar											
January	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
Prune trees and shrubs	Transplant any plants/ trees not in bloom	Plant flowers and transplants							Plant trees/shrubs and plants		
Prep ground for planting	Fertilize planting beds	Compost							Plant winter flowers		Major tree trimming
Mulch	Plant cool season flowers/plants	Mulch		No planting – Too Hot					Irrigate new plants/ trees for one year		Compost
	Prepare ground	Plant turf grass		Irrigate if necessary					Prepare ground Plant turf grass		

10.9.6 Pest Prevention Measures in Landscaping Adjacent to Buildings

Proper selection and installation of plant material can help reduce the likelihood of a pest problem. The following strategies are required for all landscaping activities.

- Keep the landscape soil line 2 to 3 inches below the slab line of the structure to prevent moisture and pest entry.
- Use a 2- to 3-inch gravel barrier approximately 6 inches deep between exterior wall and plant bed to prevent rodent burrowing and provide maneuvering difficulty for many pest. This allows access for pest surveillance, while providing a pathway for use of a chemical barrier if treatment is needed.
- Install plants so that the anticipated foliage is 18 to 24 inches or more away from perimeter walls
- Choose aphid-resistant planting material for the landscape. Aphids produce a sweet by-product “honey dew” that will attract ants and other sweet eating insects. All of the plants in Appendix I are safe to use.
- Vines that climb building walls are not permitted against buildings.
- Use a weed barrier fabric to reduce labor and chemicals needed for weed control while providing moisture retention for plant; however, a black plastic barrier is not to be used.
- Plant trees away from buildings to prevent easy access to buildings for insects and rodents. “Away” is defined as half the canopy spread of the given species.

- Give preference to plants that shed a minimum of seeds and fruits, since the seeds and fruit may attract and support insects, rodents, and undesired birds. All of the plants in Appendix I are safe to use.

High Traffic Walkways

- Do not plant blooming plants where frequent encounters with foraging bees or wasps may occur.
- Avoid or give careful consideration to planting trees that may harbor roosting or nesting birds near high traffic areas.

Any questions regarding the above information should be directed to 254-288-5030 or 254-287-2885.

The protection of native trees and planting of new native trees can provide an attractive landscape, at new barracks, Clear Creek Road.

10.10 TREE PROTECTION AND PRESERVATION

During the clearing and construction process, protect from damage all trees that are designated to be part of the final landscape. Existing urban trees and forest should be protected if they are in good health; therefore, construction should be planned.

10.10.1 Construction Activities

A Construction Staging Plan should be developed that protects as much of the site as possible, including vegetation, land contours, and existing site drainage (also see Sections 13.1 and 13.3). The plan should indicate what areas of the site are to be used, where construction activities should take place, i.e. construction staging and materials storage, and which areas should be preserved. Regarding the latter, elements to be protected should be clearly marked. All materials entering the site should have a designated site storage destination prior to their arrival. The less often that material is moved from one place to another, the less likelihood there is to damage existing vegetation.

Fort Hood Installation policy dictates that for any existing native hardwood tree that must be removed as a result of construction activities, ten native trees must be planted (10:1 ratio) to replace it. Each replacement tree shall be a minimum of 2 inches caliper in all cantonment areas. Replacement trees must be selected from the plant palette shown in Appendix I.

10.10.2 Tree Protection

Trees adequately protected within a park setting.

At Fort Hood, existing native hardwood trees are to be preserved in place and protected during construction. Unnecessary cutting or breaking of roots, skinning or bruising of bark, stockpiling construction materials within dripline, excess foot or vehicles traffic, or parking of vehicles within the dripline should be avoided. If removal of a native hardwood tree (for protection, defined as any tree greater than 3 inches in diameter measured at 4 feet from the ground) is absolutely necessary, Fort Hood Installation policy (which only applies to the cantonment area) dictates that for any existing native hardwood tree that must be removed as a result of construction activities ten native trees must be planted (10:1 ratio). Each replacement tree shall be a minimum of 2 inches caliper in all cantonment areas. Replacement trees must be selected from the plant palette shown in Appendix I.

Trees adequately protected within an urban setting.

To prevent damage to existing vegetation, it is important to adhere to the following guidelines:

- Construction barricades shall be erected to protect the existing trees to be preserved. The barricades should be no closer to the trunk of the tree than the canopy's dripline or 5 feet from the trunk, which ever distance is greater. This will help protect trees during construction from unnecessary cutting or breaking of roots, skinning or bruising of bark, stockpiling construction materials within the dripline, excess foot or vehicular traffic, or parking of vehicles within the dripline.
- Avoid placing additional soil on the ground. Changes in the grade of the soil around trees can cause extensive root damage and eventually death of the tree. Maintain the existing grade to at least the tree canopy's the drip line.
- Avoid compacting soils containing tree roots to prevent decreasing the soil oxygen level and inhibiting root growth.

- Trenching and digging near tree roots is not recommended. (Note: Roots can grow distances of one to three times the height of the tree). If trenching cannot be avoided then place the trench and associated utility no closer to the tree than the canopy dripline.

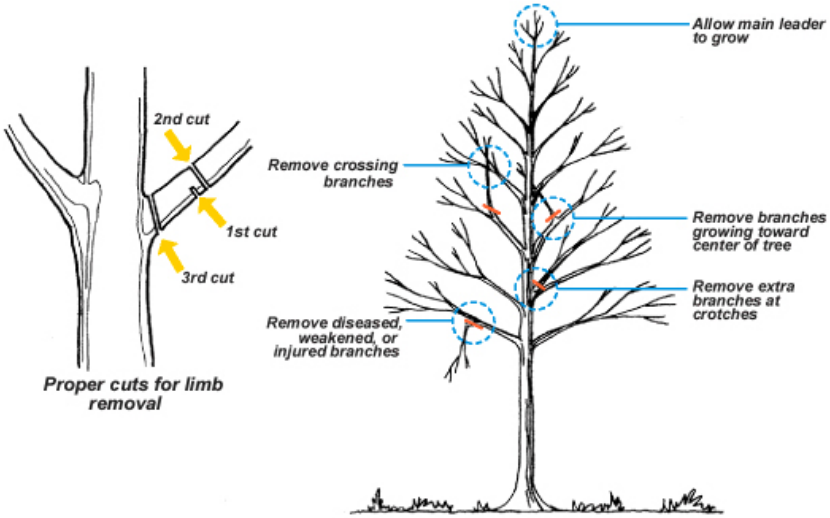
10.11 MAINTENANCE

Insufficient tree protection fencing around stand of Plateau live oak trees, resulting in severe soil compaction and backfilling of gravel over tree roots. Tree protection fencing should encompass an area extending to the drip line (or 5 feet from the trunk, which ever is greater) of the tree canopy.

Ease of maintenance is a primary goal for Fort Hood when considering the success of any planting design.

10.11.1 Pruning

In general, plant material should be allowed to conform to its natural shape. This practice allows the plant to mature in a healthy manner and reduces the time and energy required for trimming. The pruning of trees and shrubs is done to maintain overall plant health, direct plant growth, maintain a desired shape, and increase flower or fruit development. Knowledge of growth characteristics will help determine when pruning should be carried out. As a general rule, the best time of year to prune is just prior to the maximum growing period, when one can encourage either the production of flowering shoots or growth which will flower the following season.



10.11.1.1 Trees

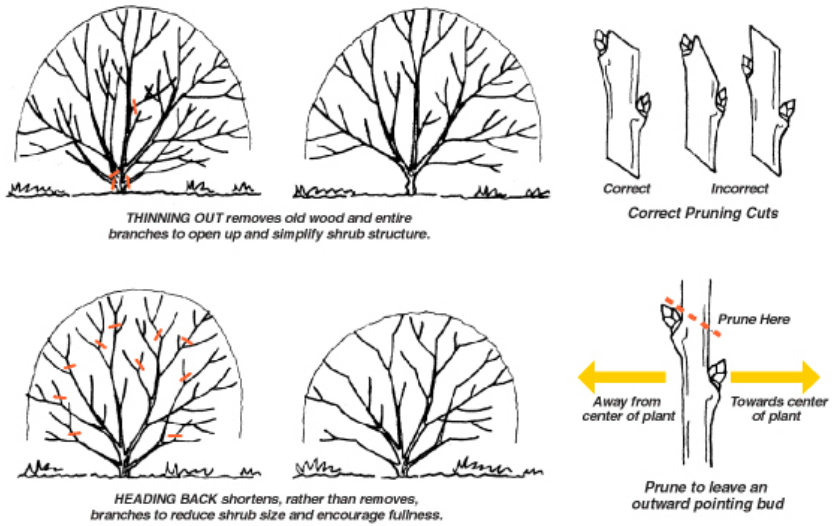
Remove a large limb by making three cuts as follows:

1. Make the first cut at the bottom of the branch 12 to 24 inches from the branch attachment.
2. Make the second cut on the top of the branch within 1 inch of the undercut.

3. Make the final cut just beyond the outer portion of the branch collar. The first two cuts were necessary to remove the weight of the branch to allow cut #3 to be clean without ripping the bark. Never cut the central leader of the tree. Coniferous evergreens trees should be pruned, during the spring, by snipping off new growth. Avoid geometrically shaping plant material while pruning.

10.11.1.2 Shrubs

Never try to fit a shrub that naturally grows to a larger size into an area where limited space is available and constant pruning will be necessary. Pruning techniques vary from shrub to shrub, depending on the plant and the effect required. Do not prune shrubs flat across the top. Prune branches yearly on thick-branched shrubs and at the base of the shrub. When pruning deciduous shrubs, prune the shrub stems as close to the ground as possible and shrub branches as close to the stem as possible. When "thinning out" deciduous shrubs, prune about one-quarter of all branches where they meet their main stem. Pruning cuts should be made just above an outward-pointing bud or shoot, or just above a strong pair of opposite buds so that the resulting shoots will be well placed in relation to the other new growths on the plants.



Shrub Pruning Techniques

Courtesy United States Air Force

10.11.2 Mulching

The best time to mulch for water conservation and to reduce weed growth is in the late spring. Additionally, apply a 2- to 4-inch thick mulch layer immediately to new fall plantings (individual plants and planting beds). Use only shredded hardwood mulch, hardwood chips, or cedar mulch. Do not use pine bark or rubber mulch. Do not use rock of any type instead of mulch.

10.11.3 Fertilization

To determine the appropriate fertilizer composition and application, soil samples should be taken and analyzed. All fertilizer application and use must be authorized by the Fort Hood Pest Management, POC: Anne Hamilton, (254) 288-3211.

10.11.4 Composting

Composting of organic materials from the solid waste stream not only provides a valuable benefit to nutrient-deficient soils, it greatly reduces the amount of waste disposed in landfills or incinerators. Other benefits of composting organic matter include the suppression of certain plant diseases, the reduced need for fertilizers and pesticides, the prevention of soil erosion and nutrient run-off, and assistance in land reclamation projects. Utilize organic compost from the Fort Hood Compost Center. For compost availability, contact the Solid Waste Contract Services Division, POC: (254) 287-5118, and the Environmental Services Division, POC: (254) 287-9184.

10.11.5 Pesticides and Herbicides

When dealing with hazardous substances, comply with regulations regarding the storage, handling, application, and disposal of hazardous substances. Certain chemicals require applicator licensing. Contact the Installation Pest Management Coordinator 254-288-5030. Do not transport, handle, store, load, apply or dispose of any hazardous substance or fertilizer in such a manner as to pollute water supplies or waterways, or cause damage or injury to land, humans, plants, or animals. Do not store, mix, or rinse hazardous substances or fertilizers below the high-water mark or where they might enter surface water. Develop a contingency plan for hazardous substance spills, including cleanup procedures and notification of the State Department of Health. Responsibly dispose of containers, cartridges, filters, used oil, and other refuse.

Use an integrated approach to weed and pest control, including manual, biological, mechanical, preventive, and chemical means. To prevent the entry of hazardous substances into surface water:

- Refer to chemical label instructions for additional guidance on use near water and required buffer zones;
- Apply chemical treatments within riparian areas only by hand with proper equipment and safety precautions and apply only to specific targets; and
- To enhance effectiveness and prevent water pollution, apply chemicals during appropriate weather conditions, generally when calm and dry, and during the optimum time for control of the target pest or weed.

10.11.6 Integrated Pest Management

Some species are naturally more resistant to pests, so they require fewer pesticides. Another alternative to pesticides is *integrated pest management*, an emerging field that uses least-toxic pest control strategies. One example is to introduce certain insects such as praying mantises or ladybugs to feed on and to limit populations of landscape-consuming pests.

10.11.7 Groundcover Maintenance

Although groundcovers do not require pruning, they may be periodically dug up in the spring or fall for propagation and to prevent overcrowding in their beds.

10.11.8 Landscape Maintenance Schedule

The general objective of a landscape maintenance schedule is to ensure orderly and efficient care of the grounds. The landscape maintenance schedule identifies times throughout the year when specified maintenance should be undertaken. Use of the landscape maintenance schedule will improve all aspects of landscape on the installation. Materials and supplies can be ordered in a timely fashion, manpower needs can be calculated and anticipated, and a correlation between the level of maintenance and appropriate costs can be derived.

General Fort Hood landscape maintenance includes:

- There are 22 scheduled mowing cycles in a year for the main cantonment area only.
- The parade fields, chapels, and Building 1001 are maintained weekly and include shrub maintenance.
- Tree trimming is handled by a separate Work Order, as needed. It is not a regularly scheduled activity.
- There is no contract for fertilizer.
- There is a contract to handle fire ants, as required.

Fort Hood Planting Calendar											
January	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
Prune trees and shrubs	Transplant any plants/trees not in bloom	Plant flowers and transplants							Plant trees/shrubs and plants		
Prep ground for planting	Fertilize planting beds	Compost							Plant winter flowers		Major tree trimming
Mulch	Plant cool season flowers/plants	Mulch		No planting – Too Hot					Irrigate new plants/ trees for one year		Compost
	Prepare ground	Plant turf grass		Irrigate if necessary					Prepare ground Plant turf grass		

10.12 ARMY STANDARDS

The cited Army Standards shall be met:

- Army Regulation (AR) 420-70, *Facilities Engineering: Buildings and Structures*, http://www.hqda.army.mil/acsimweb/fd/policy/ar420-70/main/index_txt.htm
- Technical Manual (TM) 5-630, *Natural Resources Land Management*, http://www.usace.army.mil/inet/usace-docs/armytm/tm5-630/entire.pdf
- Technical Manual (TM) 5-803-13, *Landscape Design and Planting*, http://www.usace.army.mil/inet/usace-docs/armytm/tm5-803-13/
- American Standard for Nursery Stock, ANSI Z60.1, http://www.anla.org/applications/Documents/Docs/ANLAStandard2004.pdf

10.13 REFERENCES

The following references are provided for guidance and additional sources of information:

- Barrett, M.E., June 1999, *Complying with the Edwards Aquifer Rules, Technical Guidance on Best Management Practices*, Texas Natural Resource Conservation Commission, Austin, Texas.
- Brickell, C. and D. Joyce, 1996, *The American Horticultural Society Pruning and Training*, DK Publishing, New York, New York.

- Center for Watershed Protection, Inc., 1999, *Approaches to Better Site Design*, CDROM, Ellicott City, Maryland.
- Center for Watershed Protection, Inc., 2001, *Approaches to Stormwater Treatment*, CDROM, Ellicott City, Maryland.
- Phillips, A.A., March 2003, *City of Tucson Water Harvesting Guidance Manual*, Department of Transportation, Stormwater Section, Tucson, Arizona.
- Pintor, S., Fort Hood Construction Criteria, Fort Hood Directorate of Public Works, Environmental Division Municipal Storm Water Program, Fort Hood, Texas.
- Texas Commission on Environmental Quality, March 5, 2003, TPDES Construction General Permit, Permit No. TXR150000, http://www.tceq.state.tx.us/assets/public/permitting/waterquality/attachments/stormwater/txr150000.pdf, issued by the Environmental Protection Agency Region 6, Dallas, Texas.
- Todd, W.P., AIA, and G. Vittori, 1997, *Texas Guide to Rainwater Harvesting*, Second Edition, Texas Water Development Board in Cooperation with the Center for Maximum Potential Building Systems, Austin, Texas.
- Travers, R.G., PhD, 2003, Best Management Practices, CDROM, NPS Conference Presentation, Villanova Urban Stormwater Partnership, Villanova University, Villanova, Pennsylvania.
- U.S. Department of Defense (DoD), October 25, 2001, UFC 3-210-10 Design: *Low Impact Development Manual*, http://www.wbdg.org/ccb/DOD/UFC/ufc_3_210_10.pdf, DoD, Washington, D.C.
- U.S. Department of Defense (DoD), June 30, 2000, UFC *2*-600-01*, Installation Design,* Chapter 10, http://knxas1.hsdl.nps.navy.mil/homesec/docs/dod/nps03-080504-01.pdf, DoD, Washington, D.C.
- Air Force Center for Environmental Excellence, September 1998, *USAF Landscape Design Guide*, http://www.afcee.brooks.af.mil/dc/dcd/land/ldg/index.html, AFCEE/TDD, Brooks Air Force Base, Texas.

The following resources provide more information on landscaping for energy efficiency.

- **American Nursery & Landscape Association**. http://www.anla.org/. AAN serves as a network of organizations representing garden centers, landscaping, and horticultural interests.

- **American Society of Landscape Architects (ASLA)**. http://www.asla.org/. ASLA is dedicated to the advancement of knowledge, education, and skill in the art and science of landscape architecture.

- **National Arbor Day Foundation (NADF)**. http://www.arborday.org/. NADF is a nonprofit educational organization dedicated to tree planting and conservation. NADF sponsors National Arbor Day each spring. Email: info@arborday.org

11.1 INTRODUCTION

Site elements provide an opportunity to develop an integrated and consistent visual image for the installation. The look and feel, the scale, character and color of site element features and equipment should, to the extent possible, reflect and express the vision and values of the Army and the military paradigm of force projection and order.

Site elements are organized into the following four categories of utilitarian amenities:

- **Site Furnishings**, such as benches, shelters, bus stops, and planters;
- **Signage**, including street signs, signs for way-finding, and building signs;
- **Lighting**, for pedestrians, as well as for roadways and parking lots; and
- **Utilities**.

Site elements provide an opportunity to integrate a consistent installation visual image. Site element features and equipment should, to the extent possible, reflect the local or regional design aesthetic. This allows for ease of maintenance and blending into the local community. The four categories and their effects are discussed in detail in this chapter.

11.2 OBJECTIVES

Site element plans for both existing and future development use should be prepared with the selection of site elements focused on enhancing the functionality, usability, and efficiency of Fort Hood. To this end, site elements should meet the following objectives:

- Site elements and furnishings will be used to provide a comfortable, secure, and livable environment.
- Site elements and furnishings will be used to improve the visual organization of the installation, including its facilities, open spaces, circulation, and parking areas.
- The visual impact of unsightly utilities should be reduced as much as possible.
- An appropriate balance should be achieved between aesthetic considerations, operation, and maintenance costs, energy conservation measures, and systems life.
- Site elements should be made of sustainable harvested wood, and recycled (post-consumer / post-industrial) steel and aluminum alloy, and plastic.
- Site furnishings and elements should be designed / selected to appear as part of a family of like elements. This can be achieved through consistency of a particular anatomical detail or component.

A family of site furnishings.

11.2.1 Site Elements Standardization

In conformance to the principles of consistency, uniformity, economy, sustainability, and efficiency, site elements should be standardized. There should be one style or complimentary style of bench type, bollard type, standard-mounted light fixture, etc., specified and installed within the visual zones of Fort Hood.

11.2.2 Site Element Manufacture Information

Unless otherwise noted, site furnishings manufactured by *Landscape Forms* are the minimum standard of furnishings to be used. The colors of site furnishings should also be standardized and should be either black or Charleston green; or should be of the material, or approximating the color of the material, of which the site element is made, (e.g., galvanized or stainless steel); or should conform to conventional military colors, and be easily painted and maintained. In more obscure, less-used areas

such as the rangeland and open space and recreation areas, less expensive, though equally durable site furnishings may be specified and installed. For example, as discussed below, *Landscape Forms* manufactures a family of site furnishings constructed, in part, of high-quality, recycled plastic, that is suitable for these visual zones.

Manufacturer: Landscape Forms

P.O. Box 42011
Houston, Texas 77242-2011
Phone (281)531-4447, Fax (281)531-4448
www.landscapeforms.com

Alternate fixture manufacturers of equal quality may be submitted for review and approval. Other site furnishing manufacturers' products considered to be the minimum standards for furnishings to be used at Fort Hood include:

Shelters:

Poligon: A Product of PorterCorp
4240 N. 136th Avenue
Holland, MI 49424
Phone (800)354-7721
Fax (616)399-9123
Email info@poligon.com
http://www.poligon.com

Litchfield Industries
Earthcare Series
4 Industrial Drive
Litchfield, MI 49252
Phone (800)542-5282
Fax (517) 542-3939
www.litchfieldindustries.com

Flagpoles:

Flagpole Warehouse
3600 Cantrell Industrial Court
Acworth, GA 30101
Phone (770)974-0507
Fax (770)974-4560
http://www.flagpolewarehouse.com/index.html

Outdoor Playground Equipment:

Miracle Recreation Equipment
(or approved equal)
P.O. Box 420
Monett, MO 65708
Phone (888) 458-2752
Fax (417) 235-6816
www.miracle-recreation.com

Post and Sail, Shade Structure, BP International
510 W Arizona Ave
Deland, FL 32720
Phone (800)767-2255
Fax (386)943-4060
www.ballproducts.com

Light Fixtures and Poles:

Bega Lighting
Architectural Lighting Associates, Inc.
101 Turtle Creek Boulevard
Dallas, TX 75207
Phone (214)658-9000
Fax (214)658-9002
Email bgalvin@ala-inc.net
www.bega-us.com

Poulsen Lighting
LESCO
1981 Tellepsen
Houston, TX 77023
Phone (713)923-7781
Fax (713)923-2410
www.louispoulsen.com

11.3 SITE FURNISHINGS

Outdoor furnishings should be located in coordinated clusters to provide areas of multi-furnishing amenities and to avoid the haphazard proliferation of furniture elements around the installation. All furnishings shall be accessible to, and usable by, persons with disabilities in accordance with the requirements of the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and the Uniform Federal Accessibility Standards (UFAS) with the most stringent standards to apply in the event of conflicts.

11.3.1 Objectives

- Establish a coordinated system of site furnishings that provides legibility and continuity throughout the installation to convey a sense of order and regiment.
- Select site furnishings to compliment and enhance the prevailing installation architecture.
- Site furnishings and placement should be in compliance with current Americans with Disabilities Act (ADA) requirements.
- Design and locate all site furnishings to meet antiterrorism/force protection requirements.
- Minimize maintenance and repair through the use of durable products that are vandal-proof, as well as weather-resistant.
- Site furnishings should be highly visible to encourage their use, but integrated into the physical setting. When possible, locate site furnishings against a visual background such as landscaping or a building wall.

- Site furnishings should typically be located on paved or other easily maintained surface to facilitate use and reduce maintenance requirements. The surface area should be large enough to provide easy access and accommodate the intended use.
- Site furnishings should be securely anchored or be of sufficient weight to ensure safe use and to deter theft or vandalism.
- Site furnishings should be sited to ensure human comfort and use. This includes consideration of sun and shadow patterns, precipitation, wind direction, drainage and grade conditions.
- Site furnishings placement should consider night-time use and safety, especially in terms of lighting, security, landscaping and visibility.
- All wood furnishings should have a natural finish and be allowed to weather with age. All metal furnishings should have the most durable, factory-applied finish available. The color should match the prevailing existing architectural metal on the installation.
- Use recycled/salvaged materials wherever possible.

11.3.2 Site Furnishings Elements

Site furnishings include the following elements:

- Seating;
- Tables and chairs;
- Shelters;
- Planters;
- Kiosks;
- Walls and fences;
- Trash receptacles;
- Dumpsters;
- Flagpoles;
- Bicycle racks;
- Tree grates;
- Bollards;
- Play equipment;
- Mailboxes;
- Monuments, memorials, military equipment static displays;
- Drinking fountains; and
- Telephone booths.

The *Poteskey* bench, made of 3-inch tube support material and steel rods, is appropriate for expressing the vision and values of Fort Hood.

While site furnishings at Fort Hood are comprised of a number of different elements, the elements that set the conformance standard to which all other site furnishings will be consistent are: benches, tables, chairs, and trash receptacles. To apply the standard, Fort Hood requires consistency in the look, feel, and character of these elements throughout the installation's visual zones. Fort Hood prefers the style of the *Petoskey* line of furnishings (Manufacturer: *Landscape Forms)* as the minimum standard for the highest activity areas and the most formal areas. Generally speaking, these areas include the community core, troop housing, and maintenance and warehousing visual zones. Along with the *Petoskey* line of furnishings, the designer can use elements of the *Presidio* line as these two lines are considered compatible.

The steel rod design of this *Presidio* backless bench is complementary to the *Petoskey* line.

The picnic bench in the *Gretchen* line exhibits the same tube support structure and curvature of the bench's material as the *Petoskey* line. While the *Gretchen* line can be ordered with wood seating material, Fort Hood prefers the PolySite™ material in the location where the furnishings line will be used.

PolySite™ is made from 100% high-density polyethylene (HDPE), derived from recycled post-consumer packaging such as milk containers. This reclaimed HDPE is purified and ground into small pellets. Pigment and UV inhibitors are added as the HDPE is heated, then extruded to shape and cooled. The resulting finished product contains over 90% recycled content by weight. (Source: http://landscapeforms.com/brochures/LFI_PolysiteTech.pdf)

Within the less formal visual zones, site elements constructed primarily of PolySite™ are appropriate. To maintain consistency with the *Petoskey* line of furnishings, the *Gretchen* line of site furnishings should be used in these visual zones. Elements of the *Gretchen* line possess the same tubular support look and linear seating support as the *Petoskey* line. The *Gretchen* line of PolySite™ recycled plastic material is appropriate for use in the recreation and open space, airfield, and rangeland visual zones.

Fort Hood recognizes that there will be circumstances when even a more subtle, transitional look in site furnishings is needed. To achieve this, the benching on the *Petoskey* line of furnishings can be made of the same PolySite™ recycled plastic material as the *Gretchen* line.

The *Petoskey* bench at left sets the standard for Fort Hood. The *Petoskey* bench at right has the same tube support as the more formal version, but is made with PolySite™ recycled plastic benching materials.

11.3.2.1 Seating

Seating includes benches, walls, and movable chairs.

- Benches

  - Benches should be located in areas of high pedestrian use and arranged to encourage socialization within a pleasant outdoor setting. This includes pedestrian nodes along primary walkways, at major building entryways, courtyards, and at bus stops.

  - Incorporate benches in short-term waiting areas such as building entries or plazas and in long-term waiting areas such as parks, plazas, and waiting shelters. Benches should be sited on concrete pads and located adjacent to walkways so there is adequate space between the bench and the edge of pedestrian pathways that will accommodate wheelchairs. Provide proper clearance around benches: a minimum 2-foot setback from adjacent sidewalks and a minimum of 5 feet between front of bench and any stationary obstacle. Provide appropriate planting treatment for visual definition and shade. Provide a variety of arrangements, including individual benches for quiet contemplation and study, as well as small groups of benches facing or adjacent to each other. Take advantage of good views whenever possible.

  - Benches with backs are appropriate for the informal gathering, resting, eating, and waiting uses characteristic of the Community Core and Residential Themes. Benches should be powder coated and of a neutral color that matches the surrounding architectural color. Benches without backs are suitable immediately adjacent to building walls or in

Benches without backs can be used in a variety of settings and come in a variety of colors (Manufacturer: *Landscape Forms,* styles are *Petoskey* [left] and *Presidio* [right]).

Benches should be located in areas of high pedestrian use and arranged to encourage socialization within a pleasant outdoor setting. *Petroskey* bench with PolySite™ benching. (Manufacturer: *Landscape Forms*)

areas conducive to bi-directional orientation.

- **Seating Walls**

  - Wherever possible, seating should be incorporated into planter boxes or retaining walls, particularly at building entrance areas. Seating walls should be integrated into the overall area design and the pedestrian circulation system. Planters also can provide informal seating areas and should be included in select, high-usage areas of the installation. Maintenance of the plant materials is critical to the appearance of the planters and the quantity of them should not exceed the installation's ability to adequately care for them.

Low seat walls at Darnall Hospital serve as both a low retaining wall and potential seating.

- Seating walls should generally be between 18 and 22 inches high and 12 to 18 inches wide and constructed of textured concrete or brick in a manner to complement or match the materials of the adjacent buildings.

11.3.2.2 Tables and Chairs

Locate tables together with seating that is oriented to the user needs of socializing, relaxing, or eating in less formal spaces with a pleasant setting and attractive view. Small groupings of tables in high visibility areas should be placed within proximity of recreation or food service facilities. Tables should be placed so they can be easily accessed, serviced, and maintained. These groupings should be located on hard pavement, gravel, or grass areas adjacent to walkways. Incorporate tree plantings and overhead structures to provide shade and spatial definition.

This *Petoskey* line table comes in a variety of colors.

Table with independent, detached chairs by *Landscape Forms*.

Tables should be placed so they can be easily accessed, serviced, and maintained. These groupings should be located on hard pavement, gravel, or grass areas adjacent to walkways. Incorporate tree plantings and overhead structures to provide shade and spatial definition.

Combine movable chairs with fixed tables, seating walls, and benches to create a variety of seating arrangements. Chair design should enable stacking for convenient indoor storage. Chairs should be used in indoor settings, as well as outside.

11.3.2.3 Trash Receptacles

Trash receptacles should be highly visible and accessible for effective litter control. Containers should be located conveniently along walkways, near major pedestrian intersections, near building entrances and near seating and eating areas. Furnish sufficient numbers to provide convenience for waste disposal. Locate receptacles a minimum of 5 feet away from seating or eating areas to reduce the impact of odors and insects. Antiterrorism/force protection requirements restrict the location of dumpsters to a minimum of 10 meters (33 feet) from inhabited buildings and 25 meters (82 feet) from billeting and primary gathering areas (Unified Facilities Criteria (UFC) 4-010-01, DoD Minimum Antiterrorism Standards for Buildings, Table B-1).

Containers should be a design that is compatible and in harmony with other site furnishings.

Chairs should be durable yet lightweight for indoor storage. The *Traverse* line is appropriate for use at Fort Hood (Manufacturer: *Landscape Forms*).

Trash receptacle details need to be consistent with adjacent site furnishings. The *Petoskey* trash receptacle and ash urn are pictured at left. In less formal areas, the *Gretchen* line (right) is appropriate for use (Manufacturer: *Landscape Forms*).

The *Napoleon* ash urn by *Landscape Forms* is understated yet well-designed, seen here with a Petoskey bench

Ash Urns. Provide free-standing ash urns, as well as urns integral with tables or trash receptacles. When possible, include ash urns to accommodate smokers. Locate urns at building entrances in designated exterior smoking areas. The smoking areas should include a variety of seating arrangements and locations. Furnish sufficient numbers and sizes to accommodate demand and reduce litter. Locate ash urns and smoking areas on concrete pavement to allow for easy clean-up.

Seasonal plantings within attractive planters and urns can enhance building entrances. Rosa collection, *Landscsape Forms* comes in a variety of colors.

Medium gazebo, Model #1904 - Ornate Cap Brentwood with Pre-cut Metal Roof by *Litchfield Industries.*

11.3.2.4 Planters

Planters may be used outside building entrances to provide seasonal color and interest and function as security threat barriers. Planters should be located so they block uninterrupted vehicular access to a building, but not so they excessively impede pedestrian movement. Several planters of various sizes should be grouped to produce an aesthetically pleasing display.

Planters can contribute to force protection requirements. *Rosa* collection by *Landscape Forms* comes in a variety of colors.

11.3.2.5 Shelters

There are many different types of shelters on military installations and these can serve more than one function. Possible shelter functions include telephone, automatic teller machine (ATM), drinking fountain, smoking, bus stop, vending, picnic, and restroom. Shelters are provided for waiting areas and places where people congregate to socialize or eat such as in courtyards or picnic areas.

- Shelters should be strategically located and sized for shared use to discourage the proliferation of small shelters scattered throughout the installation.

- Shelters can be open on all sides. Unless surrounding architectural character dictates otherwise, the roof should be of standing seam metal to match the surrounding architectural character. Support columns could be anchored by indigenous stone. All shelters should provide seating, trash receptacles, and ash trays/urns. When possible, locate a drinking fountain near or in the shelter. Though shelters can be different sizes and shapes, consistencies for all types of shelters should exist. This can be accomplished through the use of color and materials. An example is the use of common native stone work.

Contemporary shelter combined with native materials (Manufacturer: *Landscape Forms*).

Small shelters should be used in more intimate settings where less than 10 people would congregate. Seating should be provided by one to two benches or a picnic table. The size of the small shelters should be 8 feet by 8 feet, 10 feet by 10 feet, or 12 feet by 12 feet.

Picnic pavilions can have trellaige, or semi-open roofs, upon which ornamental vines can grow (Manufacturer: *Poligon*).

The *Ramada Shelter* (RAM) comes with a hipped roof treatment. It is available in six standard widths from 16 to 50 feet and almost any length. Single bays can be 20 or 30 feet apart depending on the model, while multiple bays are 20 feet apart. It can be customer designed for "look and feel" compatibility (Manufacturer: *Poligon*).

Medium shelter, Model 8120P, 20-foot Pittsburgh Square, by *Litchfield Industries.*

Shelters integrated with pedestrian pathways can provide provide shelter from the natural elements (Model #8220P, 20x44 feet, Pittsburgh Hip by *Litchfield Industries*).

Medium shelters and gazebos are appropriate for groups of 10 to 30 people and should be located near facilities where people congregate such as the courtyards in the Troop Housing zone, playgrounds or at the 50-foot setback from buildings for smoking and breaks.

Large shelters should be used when groups of 30 or more need to gather. These shelters should be located at focal points where special gatherings take place.

Large hexagonal shelter with a standing seam metal roof can be used for a variety of purposes (Manufacturer: *Poligon*).

Modular square shelters can cover a wide area without the massive height of a single roof. The buildings share common columns and eave beams, creating an uncluttered appearance. Different size squares can be joined to create many attractive and functional combinations (Manufacturer: *Poligon*).

- **Bus Shelters**

  - Bus shelters should be located at major facilities along the bus route such as Commissary/Post Exchange areas, barracks areas, hospital, and library. Bus stops should relate to major pedestrian walkways and be placed on concrete pads. Provide a minimum 3-foot clearance between shelters and the edge of walks.

  - Bus shelters should provide protection from wind, rain, and sun with an overhead roof with enclosure on three sides. Side enclosures should be a transparent, unbreakable type material to allow for adequate visibility. Bus shelter design typically should be simple and consistent throughout Fort Hood, matching the existing units in terms of materials, scale, and detail. Shelter design should have similar character as that for kiosks and vending machine shelters. Bus shelters should have a minimum size of 5 feet by 8 feet with a minimum height of 6 feet 6 inches from floor to underside of roof. The shelters should include an integral bench, trash receptacle, and ashtray.

The roofs of large pavilions can be split to reduce the perceived size of the roof (Manufacturer: *Poligon*).

Bus shelter materials and design should be sensitive to adjacent architecture within visual zones (Manufacturer: *Poligon*).

11.3.2.6 Kiosks

Kiosks can be used as information centers at pedestrian nodes within the town center. Provide kiosks only where they are needed on a concrete base adjacent to walkways. Allow a minimum of 3-foot clearance on all sides.

Kiosk design should blend compatibly with other site furnishings and with the architectural character of the zone in terms of form, scale, and materials. A similar design treatment should be established for kiosks and shelters.

Two-column kiosk by *Litchfield Industries (SUN)*. The design must be compatible with adjacent site furnishings.

11.3.2.7 Walls, Berms, and Fences

Existing character of low walls found on Fort Hood.

Walls and fencing should be used to provide visual screening, define pedestrian plaza areas, wind screening, pedestrian and vehicular control, security, and to retain soil. The design of walls and fences should fulfill their function in harmony with the character and appearance of their setting.

Walls and Berms

Low walls should be used to define pedestrian court areas and provide informal seating. Screening walls can be used where appropriate to screen building service areas. Walls adjacent to walkways should be free of any projections such as signs or drain pipes that would pose a hazard to passing pedestrians. Construction of walls should incorporate either brick to match adjacent buildings, with stone or concrete cap, or concrete with a textured finish and stone or concrete cap. Retaining walls may be constructed of brick, native stone, versa-lock modular stone with a light tan finish, or concrete block with a light tan stucco finish, concrete block planters, or other appropriate material. Walls used to screen service areas or trash enclosures should incorporate landscape plantings to help reduce the negative visual impact of these areas. Walls used for screening negative views shall be no less than 6 feet tall and constructed of textured concrete or brick in a manner to complement or match the materials of the adjacent buildings

Brick wall with landscaping for screening utilities at new barracks, Clear Creek Road.

Provide masonry screen walls around mechanical yards for appearance and security. The screen wall shall be provided with a lockable gate.

Use berms for screening unattractive views in more natural settings. Berm design should be integrated into the landscape and built environment, complementing architectural style, colors, and materials. Grading, drainage, and erosion control measures should be built into the design of the structures. As available, use recycled, inert, materials (e.g., concrete) for berm foundation. Use plantings to supplement berm screening structures.

Black, vinyl-coated chain-link fence provides a security barrier, but allows the look and feel of undefined space.

Fences

Wood fences shall be used for screening of service areas and site utilities, particularly dumpsters, and other unattractive views. Fences shall be a minimum of 6 feet high. Screen fencing shall consist of square tubular metal posts and rails with vertical wood fence boards. All fence posts shall be securely anchored with concrete footings. All metal posts and framework should be painted standard dark brown and wood fencing should be FSC-certified. Hardware shall be galvanized steel to prevent rust.

Use chain link fence for screening large areas. Chain link fences should be screened with trees and shrubs. The use of chain link fences for screening should be held to a minimum in the cantonment area. In high activity areas, use black, vinyl-coated chain-link fencing. Use standard galvanized chain-link fencing in low/less visibly activity areas. For additional information related to chain-link fence construction requirements, contact the DPW.

For chain-link fence:

- Check with DPW and Fort Hood Force Protection/PMO to make sure that buildings, light poles, guard shacks, mechanical systems, etc., that are adjacent to the fence do not violate Fort Hood's security requirements.
- Do not detail top pipe rail on a security fence.
- Chain-link fence fabric will be a minimum of 9-gauge and shall be tied on the side of the fence, with minimum 9-gauge wire ties not clips.
- Bottom of fence fabric must be within two inches of surface soil or pavement.
- Where gate operators are required, a manufacture's representative familiar with the design of the operator supplied and experienced in installation shall be present for installation of the operator and shall verify proper operation prior to final inspection.

Fences for outdoor swimming pools will comply with the requirements of this section and other applicable Army safety references. Swimming pools are any structure intended for swimming, recreational bathing, or wading that contains water over 24 inches (610mm) deep. This includes in-ground, above-ground and on-ground pools; hot tubs; spas and fixed-in-place wading pools. Swimming pools will be completely enclosed by a fence at least 4 feet (1,290 mm) in height or a

screen enclosure. Openings in the fence will not permit the passage of a 4-inch-diameter (102 mm) sphere. The fence or screen enclosure will be equipped with self-closing and self-latching gates.

For more information on the design and construction of walls, fences, and berms to be used for security measures see Sections 12.3.4, 12.3.1, 12.3.3, respectively.

11.3.2.8 Dumpsters

The location of dumpsters can have a significant visual impact and should be addressed as part of an overall building design and incorporated in site planning. To the greatest extent possible, incorporate dumpster placement into areas screened with walls, fencing, or plant material. Incorporate plantings to buffer the visual impact of screen walls. Walls or fencing should be a minimum of 6 feet in height. One-container dumpster areas must be 8 feet by 12 feet. Dimensions for an area containing two containers are 8 feet by 21 feet. In all cases, containers should be 3 feet from the side of the screening structure to allow adequate pedestrian and truck access. When more than one container is located within a screened area, clearance between containers must be 2 feet. Dumpsters should be painted to blend with other permanent site elements of the installation. Avoid locating dumpsters along major circulation or use areas.

Dumpster screening with masonry walls.

All dumpsters should be placed on concrete pads with aprons large enough to encompass the bearing points of the service vehicle. They should be located where they are not likely to be blocked. The refuse truck needs a minimum of 75 feet clearance in front of the container. In no cases, should the refuse collection area be designed such that the collection vehicle must back out of the access point from which it came. Dumpsters should be directly accessible by way of a paved service drive or parking lot with adequate overhead clearance for collection vehicles. Antiterrorism/force protection requirements restrict the location of dumpsters to a minimum of 10 meters (33 feet) from inhabited buildings and 25 meters (82 feet) from billeting and primary gathering areas (Unified Facilities Criteria (UFC) 4-010-01, DoD Minimum Antiterrorism Standards for Buildings, Table B-1).

11.3.2.9 Flagpoles

The standard flagpole for Fort Hood is tapered mill finish aluminum, fitted with a gold anodized finish “ball” finial. The maximum height of the flagpole shall be 25 feet. The mounting detail should be simple with a concrete base flush at grade. A concrete pad should be used when poles are located in lawn areas. In plaza areas, flagpole locations and mounting detail should be integrated into the paving pattern. Flagpoles should include lighting and may be accented with planting beds around the base of the flagpole.

11.3.2.10 Bicycle Racks

Locate bicycle racks near primary destinations, but not at building entrances or other areas of pedestrian congestion. Bicycle storage areas should be located contiguous to major parking lots and near primary pedestrian corridors. When racks must be located contiguous to a pedestrian pathway they should be set back sufficiently to avoid interference with pedestrian movement. Place bicycle racks on a paved surface, adequately sized to allow bikes to be maneuvered. Major bicycle storage sites should be located in well-illuminated, highly visible areas to ensure safety and security.

Bicycle racks may be pre-manufactured or custom designed, but of a style that compliments the installation architecture and other site furniture. Select designs that consider functionality to promote use and diminish the tendency to secure bicycles to other site elements.

External halyard ground set cone tapered aluminum flagpole by *Flagpole Warehouse*.

Bike rack can also function as a makeshift seat to lean against (Manufacturer: *Landscape Forms*).

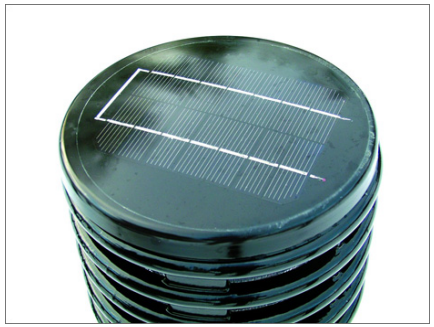
Tree grate.

11.3.2.11 Tree Grates

Tree grates should be used when installing trees in large paved areas such as pedestrian plazas, walks, and ceremonial entrance courts. Tree grates and planting pits should be a minimum of 5 feet by 5 feet. Tree grates can function as part of the LID design for stormwater management. See Section 10 for more information.

11.3.2.12 Bollards

Bollards are used as a defining element to direct pedestrian circulation along pathways, provide a safety barrier to protect pedestrian areas from vehicular traffic, and as a security bulwark to aid in force protection. When used to separate pedestrians and vehicles, bollards should be spaced sufficiently close to clearly define the desired separation of space and to prevent intrusion of automobiles, but not so close that passage of small maintenance vehicles and wheelchairs is impeded. If chain barriers are used in conjunction with bollards, care should be taken to assure that the chain is visible and not a hazard.



Integrated solar panel on bollard hood by *Landscape Forms.*

Self-contained, LED-illuminated light bollard by *Landscape Forms.*

For additional site flexibility, a removable bollard option should be considered. Removable bollards should slide into an embedded galvanized steel sleeve, and come with a keyed lock for security. Upon removal of the bollard, there should be a cover plate that fits flush within surface and can be secured.

The PB-25 series for Dura Art Stone.

Bollards manufactured by Landscape forms (www.landscapeforms.com) is the minimum design standard for the more formal, highly visible areas of Fort Hood. For the less formal areas, the PB-25 and 35 Round Series manufactured by Dura Art Stone (www.duraartstone.com) is an acceptable and complementary standard.

11.3.2.13 Playgrounds/Tot Lots

The playgrounds and tot lots within Fort Hood should use equipment that is consistent throughout the installation or that meets specific criteria of materials, color, and design.

Playground Planning and Design. Guidance for planning and designing unsupervised outdoor play areas that meet child safety and child development requirements is found in Technical Manual (TM) 5-803-11, *Children's Outdoor Play Areas*, available at http://www.usace.army.mil/inet/usace-docs/armytm/tm5-803-11/. The guidance given in this publication meets the needs of children with and without disabilities. In addition, playground equipment should be located to make use of natural shade or artificial shading systems should be installed over equipment.

Playground Inspection and Maintenance. A play area inspection and maintenance program for Child Development Centers can be found in TM 5-663, *Child Development Center, Play Area Inspection and Maintenance Program*, available at http://www.usace.army.mil/inet/usace-docs/armytm/tm5-663/.

Recalled and Banned Playground Equipment. For updates on banned or recalled playground equipment consult the Consumer Product Safety Commission Press Releases and Recalls web site at http://www.cpsc.gov/cpscpub/prerel/prerel.html.

A non-shelter playground at Fort Hood.

Shelter for playground equipment and its users is essential for comfortable year-round use.

11.3.2.14 Mailboxes

All mailboxes should be located close to the facility they serve; however, when locating mailboxes consider the potential for the site element being used as a container for the concealment of explosive, etc.

The location of mailboxes should be coordinated with the Postal Services. If group mailboxes are required, provide central locations for them adjacent to hard-surface walkways but not to impede pedestrian movement. Consider antiterrorism/force protection requirements for locating similar container types, i.e., trash receptacles that are located a minimum of 10 meters (33 feet) from inhabited buildings and 25 meters (82 feet) from billeting and primary gathering areas (*Unified Facilities Criteria (UFC) 4-010-01, DoD Minimum Antiterrorism Standards for Buildings*, Table B-1).

11.3.2.15 Monuments, Memorials, and Military Equipment Static Displays

Monuments and static displays should be carefully designed and placed in prominent locations to serve as visual focal points within the installation. Static displays of equipment should be consolidated in one location to create a central museum or exhibition facility within the installation. Memorials will conform to the guidance set forth in Army Regulation (AR) 1-33, *Memorial Programs*.

Custom waste receptacle in the *Petoskey* line (by *Landscape Forms*).

11.3.2.16 Drinking Fountains

Outdoor drinking fountains should not be provided, except to support larger playgrounds, outdoor recreation facility complexes, and outlying recreation areas if convenient to a potable water supply line. This is to ensure the water quality at the fountain meets regulatory requirements. Steps should be provided for children. The Americans with Disabilities Act Accessibility Guidelines (ADAAG) and Uniform Federal Accessibility Standards (UFAS) standards met.

11.3.2.17 Telephone Booths

Telephone booths should be incorporated into building architecture, utilizing building recesses and overhangs, or integrated into bus or other shelters. Provide a minimum 3-foot clearance between booths and the edge of walkways. All service line wiring should be underground or concealed. Booths should be equipped with lighting for nighttime use. In sheltered areas, use standard wall-mounted phone enclosures.

Customized bench by *Landscape Forms.*

11.3.3 Fort Hood Line of Furnishings

An option the Fort Hood installation may consider is developing a line of site furnishings unique to the installation. Most of the prominent landscape furnishings manufacturers have designers on staff to develop new and/or unique lines of furnishings specific to the programmatic requirements of a given project. A Fort Hood line of site furnishings that conveys the principles, vision and values of the military, and represents the specific forces at Fort Hood would help the installation develop a unique character.

Detail of customized bench by *Landscape Forms.*

11.3.4 Site Furnishings Specifications

- Site furnishings dimensions should meet specifications presented in TM 5-803-5, Installation Design Manual.
- Site furnishings partially constructed of wood (maple, oak, redwood, and pine), should possess the Forest Stewardship Council's Chain of Custody certification and the Forest Products Commission's ISO 14001 certification.
- Metal site furnishings should be undercoated with Primegard® rust proofing and finished with Pangard II® polyester powdercoat. This is an environmentally friendly metal finishing process that does not contain heavy metals (lead-free), is free of hazardous air pollutants, does not generate hazardous waste and contains less than 1% volatile organic compounds.
- For site furnishings constructed, in part, of plastic: plastic will be of 100% high-density polyethylene (HDPE) derived from recycled post-consumer packaging such as milk containers. Pigment and ultraviolet inhibitors shall be added to the HDPE resulting in a product containing over 90% recycled content by weight.
- Site furnishings must be made of sustainably harvested wood, and recycled (post-consumer / post-industrial) steel and aluminum alloy and plastic.
- Bench materials must conform to applicable American Society for Testing and Materials (ASTM) materials, welding and fastening specifications. Bench design must adhere to American National Standards Institute (ANSI) and Business and Institutional Furniture Manufacturer's Association (BIFMA).
- Benches and chairs must conform to the ANSI/BIFMA X5.4-1997 and ANSI/BIFMA X5.4-1997 for lounge seating.
- Dumpster locations shall conform to Unified Facilities Criteria (UFC) 4-010-01, DoD Minimum Antiterrorism Standards for Buildings, Table B-1.

11.3.5 Site Furnishings Manufacturers Qualifications

Preferred manufacturers of site furnishings must provide documentation for the following qualifications:

1. Manufacturer has been manufacturing the specified products or ones very similar in style and material for at least two years.
2. Manufacturer is able to fill additional orders within a 40-day schedule.
3. Manufacturer maintains a current supply contract with the General Services Administration and the Texas Multiple Awards Schedule.
4. Manufacturer can provide documentation regarding proven sustainable operating and manufacturing practices.

11.4 SIGNAGE

Signs are used to visually communicate information. They are highly visible features that should be attractive and compatible with their surroundings. Careful consideration must be given to what a sign says, how it is said, its visual appearance and organization, its location, structural support system, and relation to other signs within the installation. Standardized signage systems facilitate movement, provide a sense of orientation, and reinforce standards of excellence. Signage creates a unifying element throughout the installation that visually ties the installation themes together and builds a reference and continuity that translates into confidence and reassurance when traveling throughout the installation. The standards to apply for signage color, type, and sizing are found in Technical Manual (TM) 5-807-10, *Signage*.

11.4.1 Sign System Characteristics

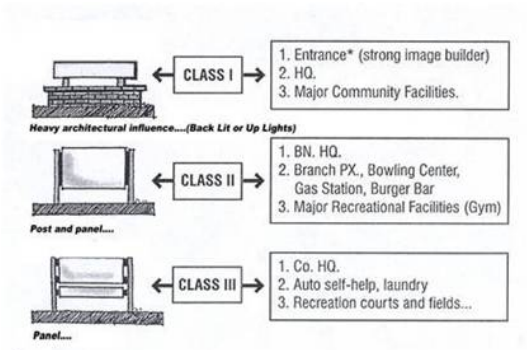
Several basic design characteristics that help to convey necessary information clearly and attractively are an integral part of any successful signage system.

Simplicity. An effective strategy provides only needed information, avoids redundancy, and eliminates over-signing with resultant clutter and visual confusion. Sign messages must be clear, simple, and easy for motorists to process quickly.

Continuity. It is essential that the system be applied uniformly and consistently throughout the entire installation. The importance of consistent implementation extends from the larger issues of sign type and size down to accurate color continuity and matching typestyles.

Visibility. Sign location is a critical ingredient within the system. Signs must be located at significant decision points and oriented to provide clear sight lines for the intended user. Close coordination of locations with respect to landscaping, utilities, adjacent signage, and various other street design elements is important to ensure long-term maximum visibility.

Legibility. Sign typestyle, line spacing, color, and size all combine to create the crucial design characteristics of legibility. This aspect of sign design should take into consideration users such as motorists, pedestrians, or bicyclists and the relative travel speed at which each type of user will be traveling when viewing the signs.



Classes within the Visual Hierarchy.

Visual Hierarchy. The entire signing system must communicate, through a range of sign and typestyle sizes, the relative importance of the individual activity that the sign identifies. The system should follow a logical progression from a point of origin to the desired destination.

A stated ranking method supports the visual standard of hierarchy within the signing system. Signs can be organized within assigned classes with emphasis on the function and image of the installation.

Within each class, the level of architectural influence evokes the importance of the sign to the installation. This is also critical to the idea of progression. The importance of a sign must be presented in its size and level of detail.

As individuals move closer to their destination on the installation, the scale of the sign becomes progressively smaller and the level of the message more detailed.

11.4.2 Types of Signs

11.4.2.1 Information / Identification Signs

These are signs that identify areas within the installation, command buildings (e.g., brigades, battalions, company headquarters, motorpools, etc.), and organizational or functional components. They identify a location and greet the visitor to that location. They should be compatible in scale and character with the architecture and should blend with the natural surroundings. Information / identification signs are designed to include the following.

Typeface:	
Lettering	self-adhesive backing material
Building Title	Helvetica Medium, upper and lower case
Building Numbers	Helvetica regular
Building Addresses	Helvetica Medium, upper and lower case

Color:	
Panel	Dark Brown
Lettering	White
Post	Dark Brown
Exposed panel backs and edges	Dark Brown
All paint	Semi-gloss

Materials:	
Panel	Double-faced 1/8-inch thick aluminum
Post	Steel pipe
Foundation	Concrete pier or direct burial

11.4.2.2 Commercial Identification Signs

Commercial Signs

- Only one ground-mounted sign and one building sign shall be allowed for each premise. An exception may be approved during the planning charrette for corner and double frontage lots.
- The design of the sign shall be coordinated with the design of the principle building(s) in terms of color, material, detailing, and style. Substantial contrast between the color and material of the background and the letters or symbols shall be used to make the sign easier to read both day and night

An example of a monument-style sign using native stone.

The use of pole signs is not permitted at Fort Hood.

- All ground-mounted signs will be monument type; pole signs are not permitted.
- Only essential information (the name of the tenant/business) shall be displayed on the monument sign.
- Monument signs shall be designed for horizontal massing, not vertical.
- Monument signs will have a base structure of a minimum height of 1 foot and a maximum height of 2 feet high. Base material shall be designed to complement the architectural style of the building and should be of native stone, brick, or as otherwise approved during the planning charrette.
- Monument sign dimensions for a single building shall not exceed 4 feet in height and 8 feet in width. This does not include base material.
- Landscaping around the sign should be avoided to minimize future maintenance.

These types of signs are not permitted for use at Fort Hood.

Lettering and Color

- Letters and words should not be spaced too closely. In general, letters should not occupy more than 75 percent of the sign panel area when external or no lighting is used.
- Lettering types shall be limited to no more than two for small signs and three for larger signs to increase legibility.
- Signs shall conform to a simple color and graphic palette in order to minimize the confusion and clutter of the sign. In general, signs shall have no more that three colors or shades of the same color.

Sign Material

- Wood, stone, brick, masonry, or metal materials are preferred.
- Polished, glossy, shiny, or reflective surfaces are not permitted.

Lighting

- All electrical wiring required for the lighting shall be hidden or located in as unobtrusive a location as possible. Any visible conduit or wires should be painted out to blend with the background.
- Moving, flashing, rotating, or twinkling lights are prohibited and shall not be used as signage. Whole panel lighted signs are not permitted.
- Illuminated signs should be designed to provide a high quality appearance in both natural light during the day and in artificial light at night.
- Use external signs over internally lit signs.
- Average illumination on the surface of signs shall not exceed 3.0 foot-candles.
- Signs should be lighted with external fluorescent luminaries or, if internally lighted, with LEDs.

Externally Lighted Signs (preferred)

- Sign lighting shall be shielded, and concentrated and focused on the sign area and not diffused over the building or property.
- Ground–mounted lighting shall be screened or partially buried to minimize the view of the light source. Bare bulbs are not permitted. The design of ground-mounted lighting shall be such that it causes no special lawn maintenance concerns. For example, the lighting type shall not be a type that requires lawn maintenance personnel to use a weed eater around the light.
- Top-mounted lighting fixtures shall be directed downwards in a manner that hides the light source.
- Up-lighting may be used if the fixture will be aimed to prevent light spillage beyond the sign.
- Back-lighted solid lettered signs are permitted.

This type of signage, including color scheme and material, is inappropriate for the landscape character of Fort Hood.

Internally Lighted Signs

- Internally illuminated signs such as the type consisting of a large rectangle metal sign cabinet with large surface areas (whole panel) of illumination that produces glare and excessive light are prohibited. No whole panel lighting is permitted.
- Internally lit signs that consist of internally lit lettering and/or symbols set against a dark background to minimize the amount of light emanating from the sign are permitted. The letters and/or symbol should constitute no more than 40 percent of the sign's surface area.
- Individual letters with interior lighting are permitted (e.g., facade signs).

Multi-Tenant Buildings or Sites

- Multi-tenant/business buildings or sites shall have one monument identification sign conveying the overall identification for the property.
- Identification signs listing multiple tenants shall exhibit a logical hierarchy in the display of information.
- Multi-tenant freestanding signs shall utilize one uniform background color for all tenants.

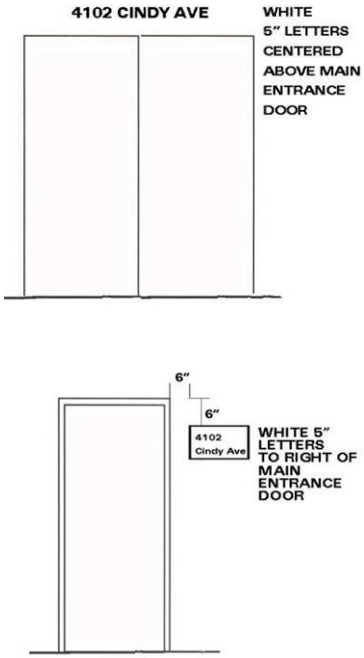
Façade-Mounted Signs

- Façade-mounted signs shall be designed as an integral element of the architecture. The shape and material of the sign shall complement the architectural features of the building.
- Signage shall be mounted with concealment hardware, or with decorative hardware to complement the design of the sign. Metal hardware shall be stainless steel or galvanized. If hardware will be painted to blend with the sign, rust-inhibiting paint shall be used.
- For single tenant buildings or site, multiple signs on the same façade are prohibited.
- For multi-tenant buildings or sites, all signage on the same façade shall be consistent in color size and elevation.

11.4.2.3 Building Identification

Street Addresses. The addressing procedures prescribed in DoD 4525.8-M, DoD Official Mail Manual are mandatory for use by all DoD components. DoD 4525.8-M, Chapter 3 prescribes the following:

- All DoD address shall be assigned so they are compatible with the United States Postal Services automated delivery point sequencing (Section C3.3 of the mail manual).
- The DoD installation is responsible for assigning city-style, street addresses on the installation (Section C3.3.2.2 of the mail manual).
- Street addresses shall be assigned and used even though a DoD activity may deliver the mail to the addressee (Section C3.3.2.2.1 of the mail manual).
- Only geographically locatable civilian-style street addresses (such as 4102 Cindy Avenue, shall be used (Section C3.3.2.2.4 of the mail manual).
- Installations shall not use one street address for the entire installation and then use secondary unit designators such as "Building 123" to designate the delivery addresses on the installation (Section C3.3.2.2.5 of the mail manual).
- Addresses such as "Building 123 Roberts Street" are not a valid address format and shall not be used (Section C3.3.2.2.6 of the mail manual).
- **Address Placement.** Place addresses by the front entrance of the building so they can be seen (Section C3.3.2.3.1 of the mail manual).



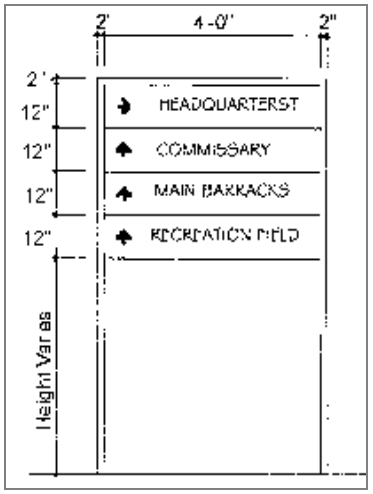
Street address location at entrance doors.

Place both the street name and address number on the building if both the building number and street address are visible from the street. Building identification signs will use street addresses. Buildings without identification signs shall have the address number and street name centered above the main entrance or located to the right side.

Housing Areas. The entrance sign should be complementary to the architectural setting of the housing area and approved by the installation Real Property Planning Board. Housing numbers should be placed on the curb in front of the respective house and on the house where lighting will effectively light the numbering.

11.4.2.4 Installation Identification Signs

Installation identification signs name the installation and display the official U.S. Army plaque. The designation “United States Army” must appear at the top of the sign in accordance with AR 420-70, para 2-7h. Every installation entrance will have an installation identification sign displaying only the U.S. Army plaque, with the words “United States Army, Fort (Name of Fort), and gate name - Installation Entrance Signs.” The placement of the Senior Mission Commander logo, unit crest, and other installation identification signs, monuments, or displays should be inside the installation beyond the cleared area of the Access Control Point of entry. When used service-wide, these signs convey a uniform image of strength and stability to the public. Emblems, branch colors, unit mottos, names, and titles of individuals are not to be displayed.



Direction sign.

Installation identification signs consist of three types:

- Sign type A1, main entrance sign, identifies the principal visitor entrance.
- Sign type A2, secondary entrance sign, identifies entry points with relatively high volumes of visitor traffic.
- Sign type A3, limited access entry gate signs, identifies entry points with limited public access.

See Technical Manual (TM) 5-807-10, Signage, paragraph 3-3, for sign specifications and paragraph 3-11 for sign placement guidelines.

11.4.2.5 Street and Contractor Signs

Design street and contractor signs with the same lettering, color and materials as other information signs. However, the standard for reflective sheeting will be diamond Grade™ Reflective Sheeting, series 4000 manufactured by 3MReflective sheeting: Diamond Grade™ Reflective Sheeting, series 4000 manufactured by 3M.

11.4.2.6 Wheeled Electrical Signs

Wheeled electrical signs will have an attractive presentation. Temporary landscape elements should be used whenever possible. The sitting of this type of sign will be approved by the Real Property Planning Board. No sign of this type will be left in place for longer than six months, after which time, the sign will be removed or turned into a permanent sign.

11.4.2.7 Directional Signs

These signs guide the motorist or pedestrian in, around, and out of the installation. The legibility and placement of these signs, as well as the ordering of information, is critical to their effectiveness. These signs should be placed in central locations and at major decision points along circulation routes. Directional signs are designed to include the following.

Typeface:	
Lettering	self-adhesive backing material
All	Helvetica Medium upper and lower case

Materials:	
Panel	Double-faced 1/8-inch thick aluminum
Post	Steel pipe
Foundation	Concrete pier or direct burial

Color:	
Panel	Dark Brown
Lettering	White
Post	Dark Brown
Exposed panel backs and edges	Dark Brown
All paint	Semi-gloss

Arrow:	
Place at end indicating direction	
Stroke width	Helvetica Medium cap

11.4.2.8 Regulatory Signs

These signs provide the rules for travel and parking on the installation. They include speed signs, turning and lane-use signs, warning signs, parking control signs, etc. Related to these signs are pavement markings and traffic signals. Regulatory signs are designed to include the following:

Typeface:	
Lettering	self-adhesive backing material
All	Helvetica Medium upper and lower case

Materials:	
Panel	Double-faced 1/8-inch thick aluminum
Post	Steel pipe
Foundation	Concrete pier or direct buria

Color:	
Panel	Dark Brown
Lettering	White
Post	Dark Brown
Exposed panel backs and edges	Dark Brown
All paint	Semi-gloss

11.4.2.9 Traffic Control Signs

National highway standards will be used for signs to regulate vehicular traffic on CONUS installations (AR 420-72, Transportation Infrastructure and Dams, Para 2-15f). These standards are described in the Manual of Uniform Traffic Control Devices (MUTCD). Also see MTMC Pamphlet 55-14, Traffic Engineering for Better Signs and Markings. This pamphlet clarifies existing standards and provides definite guidelines for installation officials to conform to the MUTCD. These standards will be used installation-wide to include installation Access Control Points.

Prohibitory (warning) signs are intended to maintain security and safety on the installation perimeter and at other specific secure areas. These signs notify visitors of restrictions as well as other security procedures. The guidelines for design, fabrication, and placement of warning signs are found in Technical Manual (TM) 5-807-10, Signage, paragraph 3-9.

11.4.2.10 Electronic Exterior Signs

All exterior flashing signs, traveling lights, or signs animated by lights of changing degrees of intensity or color are prohibited.

11.4.3 Sign Placement

Placement of signs differs according to the type of sign and the specific site constraints. The following guidelines apply to placement of the majority of signs.

- Do not place more than one sign at any location. Traffic rules are the exception to this rule.
- Place signs in areas free of visual clutter and landscape materials.
- Place signs in locations that allow enough time for the user to read and react to the message.
- Signs should not be placed to block sight lines at intersections.
- Place signs approximately 1.2 meters (4 feet) above ground level to be within 10 degrees of the driver's line of vision. Provide proper placement to avoid a hazard to children.

11.4.4 Sign System Typography

The Army has a rich tradition of military heraldry. *Military emblems* are an important part of the soldiers' identity and the emblems have been carefully crafted over the years to express unit pride

and unique history and function of the unit. The care and use of organizational emblems in a signage system can add visual interest as well as build pride and a sense of history. However, the overuse of miscellaneous emblems can lead to clutter and a dilution of their importance. Colors for military emblems must be in accordance with the Institute of Heraldry.

The Department of the Army plaque should be displayed on installation identification signage to emphasize the heritage and professionalism of the United States Army. The design of the plaque must be in accordance with Army Regulation (AR) 840-1, Department of the Army Seal, and Department of the Army Emblem and Branch of Service Plaques, and must be reproduced in full color.

The use of branch *insignia*, shoulder-sleeve insignia, coats of arms and/or distinctive insignia on headquarters signs is permitted. All military emblems must appear in full color. Motivational symbols or motifs will not be used.

Reduce visual clutter. Over-signing detracts from a uniform sign system and if left uncontrolled will eventually destroy the integrity of the system. Clutter creates confusion and ineffectiveness. Often motorist and pedestrians are confused by the bombardment of messages that have no relationship to each other or the communication is on such a minimal level that the sign serves no purpose.

11.4.5 Location Maps

The location map is an integral element of an installation entrance. The location map display provides information and sense of place to the viewer. The design and construction should be of compatible architectural materials found throughout the installation.

The location map should contain the following characteristics within the design:

- Plexiglas-covered map for protection;
- Architecturally compatible materials used for the base;
- Paved walk-up area;
- Litter receptacle;
- Adjacent parking; and
- Current takeaway maps.

Light fixture with point source element above hood provides directionality.

11.5 LIGHTING

Lighting is a functional requirement of installations that also impacts the visual environment. The installation lighting system conveys a sense of order and organization. Lighting should always be designed to fulfill a specific purpose; efficient, effective lighting provides sufficient light for the task at hand without impinging on surrounding areas.

11.5.1 Objectives

- The use of lighting should be integrally designed as part of the built environment and should reflect a balance for the lighting needs with the contextual ambient light level and surrounding nighttime characteristics of our community. Recommended light level guidelines and uniformity ratios established be the Illumination Engineering Society of North America (IESNA), in the IESNA Lighting Handbook (current edition), should be considered when determining appropriate lighting design solutions.

- Exterior lighting will employ best practice guidelines to implement high environmental lighting standards, including the use of sustainable energy where feasible, in order to prevent an increase in 'sky glow', conserve energy and minimize the unnecessary emission of greenhouse gases. Lamp and fixture types should be selected that maximize energy efficiency, lamp color rendition, lamp life, and maintenance.

- Variations in lamp types should be used to further define districts, corridors, visual zones and other physical planning distinctions.

- Avoid overlighting. Excessively bright lighting wastes energy, hampers the ability to see at night, compromises security and makes for a harsh and unattractive nighttime environment. Provide adequate light for the intended task. Focus on providing lighting uniformity, not the quantity of footcandles. Place fixtures uniformly to illuminate an area without creating bright "hot spots" with dark shadows in between. Locate luminaires to minimize shadow effects of trees and other fixed objects such as large signs or security-building walls.

- Restrict light trespass. All lighting should be located or designed to prevent undesirable spillover of light into other areas. Spotlights in particular should be aimed or screened to prevent glare that could blind motorists or pedestrians or light sleeping areas.

- Minimize or eliminate light directed upward. Avoid directing light at angles of 80% or greater, as it fails to produce useful illumination on horizontal surfaces in open areas. At these angles light produces significant glare, light pollution, and wasted energy. Direct light only where it is needed. By eliminating light spillage into surrounding areas, lower wattage lamps can be used. Avoid wall-pack and flood lighting.

- Lighting lamp and fixture type selection will utilize the latest technology for effective conversion of light into illumination.

- Light fixtures should be designed to accommodate a variety of applications, including standard-mounted, pendant, wall-mounted and bollard.

- Exterior lighting applications shall create an aesthetic appearance for nighttime illumination and lighting infrastructure during daylight hours.

- Exterior lighting applications will be developed for specific conditions, including streets and parking areas, pedestrian corridors and spaces, buildings and landscape features.

- Exterior lighting should be unobtrusive in the landscape and coordinated with other site elements to provide directionality, rhythm, uniformity, and order.

- Recognize the relationship between lighting and other landscape features such as vegetation. The placement and design of outdoor lighting need to be carefully coordinated with sensitive management of vegetation. When possible, lighting engineers should work collaboratively with the Fort Hood Agronomist (POC# 254 288-3211) in designing nighttime illumination improvements. Minimize the need to substantially trim landscaping while recognizing the need to minimize shadows and provide surveyable surroundings.

- Security lighting must conform to force protection requirements outlined within Unified Facilities Criteria (UFC) 4-010-01, DoD Minimum Antiterrorism Standards for Buildings.

11.5.2 Lighting Conditions

Five primary types of lighting conditions are found within Fort Hood. The proper types of lighting for the five lighting conditions are shown in Table 11-1. Conditions include:

Light fixture with variety of mounting options (Manufacturer: *Poulsen*).

Table 11-1
Lighting Design Matrix

		Entry Gates	Primary Roadways	Secondary Roadways	Tertiary Roadways	Primary Walkways / Bikeways	Secondary Walkways / Bike ways	Tertiary Walkways / Bike ways	Plazas / Nodes	Playgrounds	Ball fields	Basketball Courts	Tennis Courts	Buildings / Facades	Landscaping	Fence Parameters	Signs and Monuments	Large Parking Lots	Small PARKING Lots	Training Areas
LAMP	Induction		•	•	•	•	•	•	•					•		•		•		
	Halogen	•	•																	
	Mercury Vapor									•	•	•	•							
	Fluorescent													•	•					
	Metal Halide	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•
	High Pressure													•	•		•			
	LED					•	•	•									•			
	Compact Fluorescent													•	•		•			
Maximum Level	Lux (lx)		20	15	10	10	2		5		200	200	50							
	Foot-candles		2	1.4	0.9	0.9	0.5	0.5	0.5		10	20	5.6			0.5		1	1	1
Height	40' Max	•							•							•		•		
	25' Max	•				•	•	•											•	
	15' Max			•	•									•						
	Varies		•							•	•	•	•		•		•			•
Fixture	Full Cutoff		•	•	•				•									•	•	
	Cutoff/Semi Cutoff					•	•	•	•	•	•	•	•	•						
	Non Cutoff									•	•	•	•							
	Shielded														•					
	Utility	•														•				•
	Spot																•			
	Wall Mount													•						
Pole	Metal	•	•	•	•	•	•		•	•	•	•	•					•	•	
	Wood							•		•	•	•	•			•				•
Spaced	125' Max		•	•	•											•		•		
	90' Max																		•	
	Varies													•			•			•

- Roadways and parking areas;
- Pedestrian corridors and spaces;
- Buildings;
- Landscape features; and
- Security.

Minimum Design Requirements for Exterior Lighting

1. Light Fixtures and Poles manufactured by Bega Lighting and Poulsen Lighting are the minimum standard to be used in the high activity, visible areas of the Main Cantonment, and North and West Fort Hood. www.bega-us.com and www.louispoulsen.com.

2. All permanently installed outdoor luminaires employing lamps rated over 100 watts shall either have a lamp efficacy of at least 60 lumens per watt; or be controlled by a motion sensor. Except for:

   - Lighting required by a health or life safety issue including but not limited to, emergency lighting;
   - Lighting used in or around swimming pools or water features
   - Temporary outdoor lighting
   - Searchlights; and
   - Light emitting diode, neon and cold cathode lighting.

3. Control of exterior lighting may be provided by manual switches, photocontrol or astronomical time-switch controls, motion sensors, or energy management systems. For all permanently installed outdoor lighting, Fort Hood prefers lighting be controlled by photocontrol astronomical time-switch controls. Outdoor astronomical time-switch controls shall have sunrise and sunset prediction accuracy within +/- 15 minutes and timekeeping accuracy within 5 minutes per year and have an automatic daylight saving time adjustment. Photocontrols should be very sensitive to low light levels and placed in open areas, such as on roofs.

4. Proper installation is a critical component of effective exterior lighting. Light pollution and light trespass come from light emitted to areas other than the designated surface selected for illumination. Light emitted at angles of 80 degrees or higher does not contribute effectively to the illumination of horizontal surfaces. Lights aimed at 90 degrees or higher do not illuminate any horizontal surface below them; most all the illumination is emitted to the sky and results in light pollution. The light emitted to the sky reflects off dust and water vapor to create an effect known as "sky glow." By directing light only where it is needed and using luminary shielding, the maximum area of illumination per input energy is achieved, and lower-energy lamping can be used because minimal light is lost to unnecessary illumination. Light shine angles at Fort Hood, therefore, shall not exceed 80 degrees.

An example of cutoff lighting and screening dumpster areas at new barracks, Clear Creek Road.

5. Light fixture and light poles will provide for consistency and uniformity throughout the installation and must be compatible with the architectural style of the building and adjacent site furnishings; use color and materials to help provide consistency.

11.5.2.1 Roadways and Parking Areas

Streets should be illuminated to a level that provides high visibility for pedestrian and vehicular safety. The benefits of roadway lighting include reduction in night accidents, prevention of crime, improved coordination of traffic flow, and the promotion of business and community activities after daylight hours.

The motorist must be able to discern the presence and movements of objects on or adjacent to the road which may be a potential hazard. Road lighting should therefore be designed to create an even luminance on the road surface as it is seen by the motorist; other details of forms and textures are unimportant. See Table 11-1 for illumination design levels.

Parking lots should be designed to provide the minimum lighting necessary to facilitate safe movement of pedestrians and vehicles within parking areas and to prevent vandalism, auto theft, and personal crime. Lots should be uniformly lit to prevent dark spots, shadows, or excessive contrast. Major parking lots are lots with usage exceeding 50 vehicles during the nighttime peak hour. Provide an illumination design that will produce a minimum of 1 footcandle for the parking area. During periods of low usage, only security lighting is required. An electrical circuitry design should be provided that allows the illumination system to be reduced to approximately 25% of the required light level. Minor parking lots have a nighttime peak hour usage of 50 or less vehicles. Only security level lighting is required at the entrance and exit to the lot.

Standard-mounted fixtures can provide rhythm and a sense of direction to streetscapes.

Electrical feeds to lighting standards should run underground, not overhead. Lighting standards set in the perimeter of parking areas should be placed a minimum of 5 feet outside paved lot areas or 5 feet behind tire-stops. Lighting standards in the middle of parking areas should be mounted on concrete pedestals at least 30 inches high, or protected by other acceptable means. Use fully shielded lighting fixtures to minimize glare from the light-producing source.

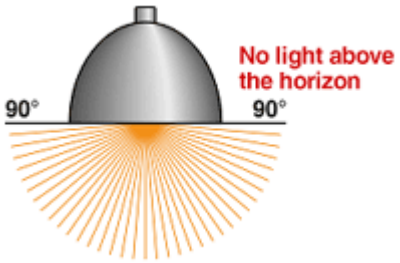


Diagram of fixture with total cut-off hood to minimize light trespass and unwanted glare.

New and replacement traffic signal lighting at Fort Hood will use light-emitting diode (LED) lamp technology. LEDs are tiny, purely electronic lights that are extremely energy efficient and have a long life. Significant savings in operating and maintenance costs resulting in a quick return on initial investment. Traffic Signal Light Systems shall be coordinated with Fort Hood DPW for preferred brand.

11.5.2.2 Pedestrian Corridors and Spaces

Ensure that main entrances, major walkways and adjacent spaces are well lighted. However, avoid deliberate lighting of open lawn expanse between paths. In general a walkway, plus about 20 feet on either side, should be adequately lit as appropriate. The network of walkways includes corresponding main entrances and parking areas.

Provide an illumination design that will produce a minimum of 0.9 footcandles for primary pedestrian sidewalks and recreational trails. Where the canopy of street trees obstructs the light from the main street lighting, additional pedestrian-scale lighting should be installed in order to meet the correct illumination standard for sidewalks.

Roadway lights and building exterior lights can serve to illuminate sidewalk and recreational trails. Maximum use will be made of multiple-purpose lighting systems. Sidewalks and recreational trails adjacent to roadways will be illuminated not less than one-half the maintained illumination required for adjacent roadways. Areas having changes in grade, such as stairs and ramps, will require special treatment. Crosswalks in the middle of a block will be illuminated to 1.5 to 2 times the normal roadway lighting level. *Secondary* and tertiary walkways and recreational trails near roadways will have 0.5 footcandles average illumination and should use LED lamps. Stairways will maintain an average of 0.6 footcandles, and overpasses will have 0.5 footcandles illumination. Walkways and bikeways remote from roadways will have a minimum of 5 lux (0.5 footcandles) average illumination measured in 10-foot intervals.

Lighting for pedestrian plazas and nodes shall be 50% higher than the paths leading to them. The spacing of lighting equipment at the node is not as important as the careful placement and alignment of equipment. Use full cutoff or cutoff (see Table 11-2) lighting pedestrian scale luminaries.

Unusual applications, such as illuminating outdoor recreation fields or facilities, need to be designed with the specific activity in mind while protecting adjacent spaces and uses from spillover light to the maximum extent possible.

Table 11-2
Luminaire Classification for Controlling Stray Light

Classification	Definition	Benefits	Limitations
Full Cutoff	Zero candela intensity at, or above, horizontal (90° above nadir). Also, candela intensity at 80° above nadir not to exceed a value equal to 10% of lamp lumens. Sometimes called "fully shielded"	Limits spill light onto adjacent property, reduces glare	May reduce pole spacing and increase pole and luminaire quantities
Cutoff	Candela intensity at, or above, horizontal (90 ° above nadir) not to exceed a value equal to 2.5% of lamp lumens. Also, candela intensity at 80° above nadir not to exceed a value equal to 10% of lamp lumens.	Small increase in high angle light allows increased pole spacing.	Allows some uplight from luminaire. Small overall impact on sky glow
Semi-Cutoff	Candela intensity at, or above, horizontal (90° above nadir) not to exceed a value equal to 5% of lamp lumens. Also, candela intensity at 80° above nadir not to exceed a value equal to 20% of lamp lumens.	High angle light accents taller vertical surfaces, such as urban environments. Most light is still directed downward	Little control of light at property line
Non-cutoff	No limitations on light distribution at or above 90°.	Uniform luminous surfaces, such as signs, globes or 'acorn' style luminaires. Wattage should be limited. Suitable for Sportslighting	Location and aiming are critical. Most likely of all lighting categories to be offensive

11.5.2.3 Buildings

Exterior lighting should be designed to assist in locating building entrances, illuminating exterior pedestrian corridors, and highlighting building elements, signs, or other distinctive features, rather than attracting attention to the light fixture itself. Only portion of the building façade shall be lighted. It is preferred that they façade by lighted from the top of the building to minimize light pollution. The maximum illumination on any vertical wall surface or angular roof surface will not exceed 2.5 footcandles. Light levels will be limited to 0.1 footcandle at the roofline and exterior corners, so as to prevent light trespass and skyglow. The exterior direct view of bare lamps is not allowed.

Wall-mounted lights accentuate rhythm of columns (Manufacturer: *Bega*).

Lights on standards (also referred to as “lightpoles”) will not be taller than the building whose area they illuminate nor taller than 15 feet, whichever is shorter, unless otherwise determined during the planning charrette. Any facilities that may require floodlighting will not arrange the light in such a way that it shines toward roadways or into the night sky. Building lighting should provide an even illumination level. No flashing, pulsating, or similar dynamic lighting is permitted. Provide indirect lighting whenever possible.

Lighting is required at all building entry and exit points. Use a hierarchy of light levels and surrounding facade brightness with major entry points having the highest light levels and most prominence. Main entry points shall be lighted to provide a “glow” at night with recessed downlights or luminaires integrated with the architecture. Appropriate types of lighting would include wall mounted sconce, recessed downlight, or wallwasher. Scones shall use low wattage compact fluorescent lamps.

11.5.2.4 Landscape Features (including signage)

Accent lighting can be used to highlight significant architectural, landscape features, and signage; however, washing a building in light should be avoided. All fixtures should be carefully aimed to direct light only where needed. All lighting, except security and entrance door lighting, will be controlled by timers and set to go off no later than 11 p.m.

In retail signage, illuminated signs should be designed to provide a high-quality appearance in both natural light during the day and in artificial light at night. Moving, flashing, rotating, or twinkling lights are prohibited and shall not be used as signage. Whole-panel lighted signs are not permitted. All electrical wiring required for the lighting shall be hidden or located in as unobtrusive a location as possible. Any visible conduit or wires should be painted out to blend with the background. The average

illumination on the surface of a sign shall not exceed 3.0 footcandles. Signs should be lighted with external fluorescent luminaries or, if internally lighted, with LEDs.

Externally lighted signs are preferred for use at Fort Hood. When signage is illuminated using an external illumination source, the sign lighting shall be shielded and concentrated and focused on the sign area and not diffused over the building or property. Ground-mounted lighting shall be screened or partially buried to minimize the view of the light source. Bare bulbs are not permitted. Top-mounted lighting fixtures shall be directed downwards in a manner that hides the light source. Up-lighting may be used if the fixture is aimed to prevent light spillage beyond the sign. Back-lighted solid lettered signs are permitted.

Internally lit signs should not become major sources of light in their own right. Internally illuminated signs such as the type consisting of a large rectangle metal sign cabinet with large surface areas (whole panel) of illumination that produces glare and excessive light are prohibited. Internally lit signs that consist of internally lit lettering and/or symbols set against a dark background to minimize the amount of light emanating from the sign are permitted. The letters and/or symbol should constitute no more than 40 percent of the sign's surface area. Individual letters with interior lighting are permitted. (e.g., facade signs).

11.5.2.5 Security

Security lighting will be designed and installed in conformance to TM 5-811-1/AFJMAN 32-1080. Security lighting should be designed to illuminate a site area or building for all to see, creating a direct visual deterrent to criminal activity. Lighting fixtures that are aimed at a building are more effective for security than fixtures that are mounted on the building and that can blind observers of the property (police, neighbors, or others).

Passive infrared detectors (PIR) should be used whenever possible. For domestic and small-scale security lighting, a 150-watt (2,000-lumen) tungsten halogen lamp is more than adequate. Higher wattage lamps create too much light, more glare, and darker shadows. Motion detector-activated lighting uses less energy and provides better security than constant light. Encourage low-level lighting which works better with closed-circuit television cameras. Encourage alarms and other security measurers, which are more successful than constant lighting. Both systems have their place and neither should cause light pollution provided they are carefully designed, correctly installed, and well maintained.

Security lighting should especially be designed to control glare and direct view of illumination sources, and to confine illumination to the property on which the fixtures are located.

For security lighting, the minimum light level is required:

- Active building entrances: 5.0 footcandles maximum;
- Infrequently used entrances: 0.5 to 1.0 footcandles;
- Building grounds: 0.5 to 1.0 footcandles;
- Industrial storage yards: 0.5 to 1.0 footcandles; and
- ATMs: 10 footcandles within 5 feet of ATM, then 2.0 footcandles for 50 feet surrounding machine, including parking area.

11.5.3 Lighting System – Anatomy

A lighting system provides the proper type of lighting for different lighting requirements, conditions, and locations. A system is composed of six primary components: fixtures, light height, type of pole, light spacing, type of lamp, and level of intensity of lamp.

Light Fixtures. A lighting fixture is the frame or housing for holding the lamp in position and for protecting it from damage. Light fixtures should be selected and located to maintain the minimum foot-candle requirements for safety and security purposes. Beyond that, aesthetic considerations should take precedence.

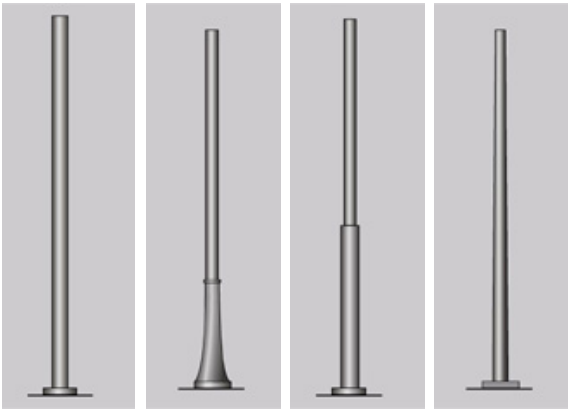
Lighting fixtures can be grouped into five general categories as defined below.

Utility Lighting. Refers to simple, inexpensive fixtures that are used in industrial areas of low visibility.

Bollard Lighting. Refers to fixtures that are mounted on or in a short post to illuminate pedestrian areas. Where security concerns demand lighting that is off the grid, lighted bollards should use self-contained, solar-powered, LED technology.

Spotlighting. Refers to high intensity fixtures that concentrate light into a narrow beam and are used to highlight signs and other important objects. Spotlights should be screened by landscaping or other methods so they are inconspicuous during the day.

Wall-Mounted Lighting. Refers to fixtures attached to the wall of a building or a wall bordering a walkway or stairway. This also includes niche mounted wall lighting to light small niches to improve safety concerns at night.



Variations in light standard (pole) detailing (Manufacturer: *Poulsen*).

Standard-Mounted Lighting. The light fixture size should be proportional to the intended height of the standard, commonly referred to as the "pole." Light standards should be consistent and provide uniformity throughout the installation. The general standard for Fort Hood is metal poles, which should be used except in remote area. Metal pole standards range in design character. They can be smooth or fluted. All metal poles shall be mounted on a concrete base. The base of the standard can also vary and degree of detail.

A variation of standard-mounted lighting with specific applications is cut-off lighting. Cut-off lighting refers to the large shoebox-shaped fixtures placed on tall poles and used to illuminate streets and parking lots. They are designed to cut off light traveling to the top and sides of the fixtures, concentrating it down onto the parking lot. The fixtures reduce the spillover of light where it is not wanted. Use full cut-off fixtures, shades, or highly focused lamps to avoid spillover. Linear "tube lights," fiber-optics, and electro-luminescent fixtures can light the way for pedestrians without over-illuminating a much larger area.

11.5.4 Lamp Characteristics

Selection of a lamp involves evaluating its optical control, efficiency, lamp color rendition, lamp life, cost, and maintenance. The following is a summary of the characteristics of typical lamp types. Recommended locations for the seven types are included in Table 11-1.

Induction lighting

- Ultra-long life span;
- Low total cost reduced energy and maintenance costs;
- Good color performance;
- High reliability - instant hot and cold start-up and re-start;
- Stable light output; and
- High efficacy.

High-Pressure Sodium

- Poor color rendition;
- Broad application;
- Low maintenance;
- Superior optical control;
- Superior life span;
- Excellent efficiency; and
- Expensive.

Low-Pressure Sodium

- Poor color rendition;
- Good efficiency;
- Superior life span; and
- Expensive.

Fluorescent

- Good color rendition;
- Poor optical control;
- Good life span;
- Good efficiency in mild climates;
- Produces glare; and
- Low temperature.

Metal Halide

- Superior color rendition;
- Superior optical control;
- Efficiency better than mercury vapor but poorer than pressure sodium; and
- Expensive.

Mercury Vapor

- Good color rendition;
- Good foliage lighting;
- Good life span;
- Good efficiency; and
- Inexpensive.

Light-Emitting Diode (LED)

- Good color rendition;
- Superior life span;
- Excellent efficiency; and
- Extremely low maintenance.

11.5.5 Installation and Maintenance of Exterior Lighting

Effective illumination of outdoor areas requires, not only the proper selection of the lighting systems, but also the proper installation and maintenance of the system.

As mentioned previously, proper installation is a critical component of effective exterior lighting. Light pollution and light trespass come from light emitted to areas other than the designated surface selected for illumination. Light emitted at angles of 80 degrees or higher does not contribute effectively to the illumination of horizontal surfaces. Lights aimed at 90 degrees or higher do not illuminate any horizontal surface below them; most all the illumination is emitted to the sky and results in light pollution. The light emitted to the sky reflects off dust and water vapor to create an effect known as "sky glow." By directing light only where it is needed and using luminary shielding, the maximum area of illumination per input energy is achieved, and lower-energy lamping can be used because minimal light is lost to unnecessary illumination. Light shine angles at Fort Hood, therefore, shall not exceed 80 degrees and illuminating shielding should be considered.

Following installation, routine fixture maintenance is critical to obtaining maximum illumination value from the lighting system operation. Accrual of dirt and insects on light-emitting surfaces reduces light output from fixtures, and thus, must be routinely removed. Vegetation beneath poles should be trimmed to minimize blocking of luminance surfaces. Timer settings should be checked to ensure optimization of operation times. During those checks, lenses should be cleaned of insects and particulate matter and luminary re-aiming should be performed.

Maintenance costs can be reduced by providing long ballast and lamp lives, and by providing fixtures that are resistant to dirt, animal droppings, bird nests, insect infestation, vandalism, and water damage. Additionally, it will be the practice of Fort Hood to *relamp fixtures* in a given area in order to reduce maintenance costs, lamp stocking, and light depreciation toward the end of lamp life.

Relamp Fixtures

Each lamp has a specific "life" or burn hours before it starts failing. Lamp failure typically happens at the same time for all lamps in a facility, as they were installed at the same time with the same burn hours. Replacing lamps individually is called spot relamping and is very costly. Spot relamping does not allow the benefit of buying bulk quantities of lamps. On the other hand, group relamping (the utility-recommended solution) relamps all the lights in the facility once a few start to fail. Group relamping, as opposed to spot relamping, costs up to four times less and saves time.

11.6 UTILITIES

Utility systems provide the basic infrastructure of power, communication, water, and sewer services necessary for the operation of the installation. Utilities play a key role in the visual quality on an installation. Their primary impact on the visual quality is the result of the clutter of overhead utility lines and poorly designed storm drainage systems. At Fort Hood utility lines shall be bored, jacked, or

tunneled under roads and streets, unless otherwise indicated in the contract specifications or drawings.

For additional information related to excavation, trenching, and backfilling for utilities systems, contact the DPW.

11.6.1 Objectives

- Minimize negative visual impacts of all utility systems.
- Minimize environmental impacts of all utility systems.

The visual and environmental impact of utilities should be minimized on the installation. Also, the systems should be designed to minimize maintenance and repair. The result is a more sustainable utility system that will promote the overall sustainability of the installation. The primary components of the utility system and recommendations for their location and design are included below.

11.6.2 Excavation, Trenching, and Backfilling

Utility lines shall be bored, jacked or tunneled under roads and streets, unless otherwise approved by the Chief of Real Property Planning Division, DPW. Grade 5 and 6 crushed rock backfill may be used for backfill provided this material is installed no more than 1 foot lifts and compacted with a vibrating plate. All backfill around manholes and valves shall be cohesive type.

11.6.3 Overhead Transmission Lines

Unsightly overhead utilities should be relocated underground, wherever possible, to reduce negative visual impacts and reduce maintenance and repair requirements. Underground utilities are also desirable for protection from terrorist or other enemy attack. When underground locations are not possible, the negative visual impacts should be minimized by using the following design techniques.

11.6.3.1 Location

Overhead transmission lines should be aligned along edges of land use areas to avoid dividing an area and creating gaps or unusable areas. They should conform to natural landforms that can be utilized to screen them from public view. Hills should be crossed obliquely rather than at right angles. Alignments along hillcrests or steep grades should be avoided.

11.6.3.2 View Screening

Minimize long views or silhouette views of overhead transmission lines from along roads and other public viewing areas. Avoid the “tunnel effect” of long, straight, uninterrupted views along the alignment by clearing vegetation only within the right-of-way that threatens the overhead lines. Jog the alignment at road crossings and periodically undulate and feature plant materials along the edges of the right-of-way.

11.6.4 Distribution Lines

On the right – trees soften the impact of overhead lines.

Power distribution lines should also be located underground to minimize negative visual impact, reduce maintenance, and protect from terrorist or other enemy attack. If overhead, they should be located out of view from main public visibility areas or screened to be as unobtrusive as possible. Avoid alignments of overhead lines along major circulation corridors. Use minor streets, alleyways, rear lot lines, and vegetation or topography that provide screening and minimize visual impact. Minimize the number of poles and pole height and use poles that blend into their surroundings to reduce visual impact. Poles should also be multi-functional for power, telephone, cable television, street lighting, etc., to reduce visual clutter.

For electrical distribution systems:

- Use armor rods rather than ties for connection of conductors to pin insulators.
- Use heavy duty air switches with arc snuffers for all branch distribution circuits that serve several buildings.
- Provide fiberglass guy insulators for all guys that come in proximity to phase conductors.
- Use three quarters inch minimum size bolts for pole hardware.
- Use spring washers under all hardware bolts including cross-arms.
- Use flat metal braces or wood braces for #4 ASCR conductors and smaller. Use angle braces for conductors larger than #4 ASCR.
- Provide at least one thru bolt for all pole-mounted floodlights. Do not use lag bolts.
- Use metal gains for all cross-arms that do not come pre-gained.

- Use arm construction rather than armless construction for 3 phase aerial lines and equipment poles.
- Use minimum three quarter inch diameter ground rods.
- Use ACSR aluminum rather than copper for all aerial conductors.
- At the pole mounted overhead to underground transition, use wet process porcelain terminators rather than the elastomeric terminators.
- Use the two bushing aerial pole mount transformers rather than the self protected (lightning arrestors) transformers.
- Connect line to lightning arrestors to cutout rather than from line to cutout and jumper to lightning arrestor.
- Provide 29 foot clearance of electrical high voltage lines at street crossing.
- Provide 480 volt street light voltage.
- All underground primary is to be encased in conduit and concrete with color coded PE secondary use marker tape, minimum 12 inches below finished grade, except in isolated areas.
- Design for aerial hot work. Main distribution outages may not be available.

For additional information related to aerial electrical distribution system construction requirements contact the DPW.

11.6.5 Substations and Transformers

Substations and transformers should be designed and located to minimize their visual impact and be compatible with the character of their setting. Substations are best located in industrial use areas rather than in major public circulation areas. They should be screened from public view by using plant material, berms, fences, and walls.

11.6.6 Sewer and Water

Sewer Systems

Sewages systems will be designed for compliance with TAC Chapter 317 Design Criteria for Sewage Systems which sets minimum standards necessary for domestic wastewater treatment systems to function properly and meet requirements for effluent quality. The criteria also contain certain safety standards.

For sanitary sewers:

- All sewer lines should be underground.
- Use SDR-26 PVC pipe for sewer piping. PVC will be used rather than metal underground, to avoid requirement for cathodic protection (A waiver is required).
- A tracer wire is not required with a sewer pipe system.
- Sewer mains will be a minimum of 8-inches in diameter.
- A buildings sewer connection will use at minimum, a 6-inch diameter pipe to allow maintenance personnel to 'jet' a plugged sewer line.
- Two-way cleanouts will be provided at the buildings sewer connection and every 150 feet along a sewer branch from a building.
- Exact coordinates will be provided to an accuracy of 6 inches and invert elevation to an accuracy of 1/10 foot for the sewer connection to a building. This information will be provided for both the plumbing and civil drawings.
- A manhole will be provided at every change of direction of the sewer line and every 400 feet.
- Use a drop manhole if elevation change is more than 18 inches (per standard criteria).
- Sewage treatment facilities should be located 1,250 feet (0.38 kilometers) distance and in a downwind direction from all inhabited facilities.
- Treatment facilities should be screened from view of major roads and other installation facilities by plant material, berms, walls, and fences.

The use of sewer lift stations will be minimized. If a lift station is required:

- A packaged unit assembled of coated metals, that will not corrode easily, will be used.
- An audible and visible alarm will be provided in case of a malfunction.
- The lift station shall be accessible to DPW service trucks.
- In remote areas, an alarm shall be installed that transmits an FM signal to DPW.
- If the location is remote and away from a main road, a gravel surfaced road will be built to the lift station.

Drinking Water Systems

Drinking water systems will be designed for compliance with TAC Chapter 290, Public Drinking Water which provides for, among other requirements, rules and regulations for public water systems. A Customer Service Inspection must be completed prior to providing continuous water service to new construction; on any existing service when the water purveyor has reason to believe that cross-connections or other potential contaminant hazards exist; or after any material improvement, correction, or addition to the private water distribution facilities. Government approval of the inspection is required.

For water systems:

- All water lines should be underground. Use PVC rather than ferrous metal underground when feasible.
- A tracer wire and marking tape shall be installed with all water service, irrigation, and distribution lines. Tracer wire shall be #10 Thermoplastic High Heat Resistant Nylon Coated (THHN) solid copper. Tracer wires shall be installed below pipe and bedding, so wire is not disturbed during repairs. The tracer wire shall be continuous between valves, hand holes and manholes. The tracer wire shall surface at each manhole, handhold, and valve box. The tracer wire shall be tested and proved continuous prior to final inspection of DPW. Marking tape shall be colored, installed 12 inches below grade, foil backing is not necessary.

- Preference is to use PVC C-900 pipe for under 18 inches and ductile iron or CSC (Hanson) for 20 inch and larger.
- Provide isolation valves at underground tees of crosses.
- Ensure valve boxes are at least 6 inches or larger to provide tool access.

For additional information related to water line installation, connection, and plumbing construction requirements, as well as sanitary sewer construction requirements, contact the DPW: 254 287-4256.

Water Storage Tanks

Water Storage Tank Painting. With the following exception, water storage tanks will be finished with a solid tan or sky blue color (see Appendix F).

Note: Any painting of or the addition of equipment or signage to a water storage tank must be reviewed and approved by the Directorate of Public Works prior to the start of any such work.

Water Storage Tank Lighting. Lighting of water storage tanks will be as prescribed in Advisory Circular AC 70/7460-1K, Obstruction Marking and Lighting.

Backflow Preventers

The Fort Hood standard is to place all backflow devices above ground, even though the TCEQC allows double check valve assemblies to be placed underground. Backflow devices can be installed in a vault on a temporary basis only, but it must be installed above grade in a hot box for a permanent installation.

Fire Hydrants

A 6 inch shutoff valve will be provided with each fire hydrant. If bollards are installed next to a hydrant, ample space will be provided to allow for access.

Fire hydrants should be highly visible and free of any screening. They shall be nutmeg brown in color with a reflective finish luminous paint. In accordance with the National Fire Protection Association (NFPA) 291, Recommended Practice for Fire Flow Testing and Marking of Hydrants, a hydrant classification color accent band will be painted on the bonnet indicating the rated capacity. Table 11-3 identifies the proper accent color band to be applied.

Table 11-3 Fire Hydrant Accent Band Chart		
Class	**Rated Flow Capacity Gallons Per Minute (gpm) Liters per minute (L/min)**	**Accent Band Color**
Class AA	1,500 gpm (5,680 L/min) or greater	Light Blue
Class A	1,000 to 1,499 gpm (3,785 to 5,675 L/min)	Green
Class B	500 to 999 gpm (1,900 to 3,780 L/min)	Orange
Class C	0 to 499 gpm (1,899 L/min)	Red

11.6.7 Storm Drainage

Installation storm drainage systems should be appropriate to the character of development they serve. Stormwater drainage systems shall adhere to the principals of Low-Impact Development (LID; see Section 10.4.2) which is a stormwater management approach with the basic premise that "nature knows best." Rather than collecting and conveying stormwater off-site through pipes and other conveyance systems, LID-designed sites use vegetation and small-scale hydrologic controls to capture, treat, and infiltrate stormwater on-site, helping to maintain the natural hydrology as development occurs. The principals of LID shall be used for storm drainage systems in all cantonment areas and other residential areas when curbs and gutters are required. Storm drainage systems in low-density areas can utilize drainage swales and ditches that are contoured to be compatible with the natural landform. Where retention ponds are required, they should be designed to appear as a natural amenity that is part of the natural contour of the land rather than a square or rectangular hole in the ground. Retention ponds that are designed to be dry most of the time can be utilized for recreational purposes or as open space. In either case, the areas should be designed to conform to the natural contours of the land parking lots should have covered drainage at the entry to prevent water draining into adjacent streets.

For additional information related to storm water construction requirements, contact DPW.

11.6.8 Natural Gas Line

All natural gas lines should be underground. As required, the aboveground infrastructure should be screened from view of major roads and other installation facilities by plant material, berms, walls, and fences.

For Gas Distribution Systems:

All buildings served, except family housing units, shall be metered and have a gas pressure regulator. The meter shall have a bypass so if removed for servicing; the building can still be supplied with gas. Provide a ¾ inch plugged tap on each side of the pressure regulator so the pressure can be checked for proper operation.

Provide poly valves in lieu of metal for underground gas valves.

DPW will make the determination whether or not the distribution pressure gas service is sufficient to serve a proposed project. DPW will indicate the location where the gas distribution system will be tapped.

A tracer wire and marking tape shall be installed with all gas service and distribution lines. Tracer wire shall be #10 THHN solid copper. Tracer wires shall be installed below pipe and bedding, so wire is not disturbed during repairs to the system. The tracer wire shall be continuous between valves, hand holds, and manholes. The tracer wire shall also surface at each manhole, handhold and valve box. A coil of at least 1 foot of wire shall be left in each hand hole and valve box. Tracer wire shall be tested and proved continuous prior to final inspection with DPW. Marking tape shall be color coded, installed 12 inches below grade, and foil backing is not necessary.

Provide anodeless riser to regulator.

Lines to regulators shall not be less than 1 inch.

Use PE rather than ferrous metal underground when feasible. Limit gas valves to 8 inches and ensure valve boxes are at least 6 inches or larger to allow tool access.

For additional information related to gas distribution construction requirements, contact the DPW.

11.6.9 Towers and Poles (Communication and Mass Notification Systems)

All communication towers and mass notification towers/poles must be designed and located to minimize impact to the natural views at Fort Hood. The tower/pole color must be considered, and reviewed for compatibility with the surrounding environment and background. The base of the tower and all other ancillary infrastructure supporting the tower must be screened from view. All proposed towers/poles locations must be submitted to the Federal Aviation Administration for review.

11.7 ARMY STANDARDS

The cited Army Standards shall be met.

- Americans with Disabilities Act Accessibility Guidelines (ADAAG), http://www.access-board.gov/adaag/html/adaag.htm
- Army Regulation (AR) 420-49, Utility Services, http://www.usapa.army.mil/pdffiles/r420_49.pdf
- AR 420-70, Buildings and Structures, http://www.hqda.army.mil/acsimweb/fd/policy/ar420-70/index.htm
- AR 420-72, Transportation Infrastructure and Dams, http://www.hqda.army.mil/acsimweb/fd/policy/ar420_72/index.htm
- DoD 4525.8-M, DoD Official Mail Manual, http://www.dtic.mil/whs/directives/corres/html/45258m.htm
- Manual of Uniform Traffic Control Devices (MUTCD), http://mutcd.fhwa.dot.gov/
- MTMC Pamphlet 55-14, Traffic Engineering for Better Signs and Markings, http://www.tea.army.mil/pubs/nr/dod/pmd/PAM_55-14.htm
- Technical Manual (TM) 5-807-10, Signage, http://www.usace.army.mil/inet/usace-docs/armytm/tm5-807-10/

- Unified Facilities Criteria (UFC) 4-010-01, DoD Minimum Antiterrorism Standards for Buildings, http://www.wbdg.org/ccb/DOD/UFC/4_010_01.pdf
- Uniform Federal Accessibility Standards (UFAS), http://www.access-board.gov/ufas/ufas-html/ufas.htm

11.8 REFERENCES

The following references are provided for guidance.

- AR 1-33, Memorial Programs, http://www.usapa.army.mil/pdffiles/r1_33.pdf
- AR 840-1, Department of the Army Seal, and Department of the Army Emblem and Branch of Service Plaques, http://www.usapa.army.mil/pdffiles/r840_1.pdf
- TM 5-663, Child Development Center, Play Area Inspection and Maintenance Program, http://www.usace.army.mil/inet/usace-docs/armytm/tm5-663/
- TM 5-803-11/Air Force AFJMAN 32-10139, Children's Outdoor Play Areas, http://www.usace.army.mil/inet/usace-docs/armytm/tm5-803-11/
- TM 5-803-5, Installation Design Manual, http://www.usace.army.mil/inet/usace-docs/armytm/tm5-803-5/entire.pdf
- UFC 2-600-01, Installation Design, Chapter 11, http://knxas1.hsdl.nps.navy.mil/homesec/docs/dod/nps03-080504-01.pdf

Accommodating the need for security and antiterrorism is a significant concern for all military facilities design. Fort Hood requires security and safety measures to be considered within a total project context, including impacts on occupants and the environment, regardless of the level of protection deemed appropriate. By emphasizing an integrated or "whole site" design process, areas of synergy and potential conflicts between sustainable and security/safety approaches can be identified and sustainability opportunities can be highlighted within certain security/safety strategies. Fort Hood requires that site elements used in force protection such as fences, lighting, screen walls, berms, planters, and retaining walls, use materials that support the sustainable approach discussed in Section 11 of this IDG. In addition to new material products, recovered inert materials (e.g., stone, concrete, masonry, etc.) from demolition activities shall be considered (see Section 13.4) for use in implementing force protection measures. As noted in Section 12.2, there are landscape considerations for force protection. All landscape material must be consistent with the requirements outlined in Section 10, Landscape, of this IDG. All design elements shall provide visual harmony with the main facility, producing architectural compatibility through consistent use and application of materials, forms, and colors.

Questions related to security and fire protection must be directed to the following Fort Hood Departments:

Force Protection and Security – Responsible for:

1. UFC 4-010-01, 08 October 03, "DoD Minimum Antiterrorism Standards for Buildings"
2. UFC 4-010-02, 08 October 03, "DoD Antiterrorism Standoff Distances for Buildings"
3. AR 190-51, 30 September 93, Security of Unclassified Army Property (Sensitive and Non-sensitive)

Force Protection questions shall be directed to: 254-553-2782 or 288-6466

Security questions shall be directed to 254-287-4915

Fire Prevention/Mass Notification Systems – Responsible for:

1. UFC 4-021-01, dated 18 Dec 02, "Design and O&M: Mass Notification Systems"
2. Guide Specification 13857, "Mass Notification System"
3. UFC 3-600-01, 17 April 03, "Fire Protection"

Fire prevention/mass notification questions shall be directed to: 254-287-4915

Table 12-1 identifies sustainable design considerations and opportunities for safety and security for Fort Hood. Implementation of these strategies must be compatible with Army Regulations (AR) and Unified Facilities Codes (UFCs) related to force protection. The potential use of these strategies shall be initiated during the planning charrette.

Final design decisions to meet security and antiterrorism requirements and resolve conflicts will require coordination among the design disciplines and appropriate functional areas to include land planners, landscape architects, architects, intelligence personnel, security personnel, the Force Protection Officer, facility users, and engineers. The designers must work to balance force protection requirements with all other requirements that impact design and development. These include, but are not limited to, the Americans with Disabilities Act Accessibility Guidelines (ADAAG), the Uniform Federal Accessibility Standards (UFAS), National Fire Protection Association's (NFPA's) National Fire Protection Codes, and all applicable federal, local, and state requirements (e.g., code, ordinances). The design team will also consult security personnel to determine whether portions of the design documents are subject to access limitations.

12.1 BUILDING SITING AND DESIGN STANDARDS

12.1.1 Minimum Standards

A primary concern for Army installations throughout the world is the threat of terrorist attack. To minimize the likelihood of mass casualties from terrorist attacks against DoD personnel in the buildings in which they work and live, DoD has developed the Unified Facilities Criteria (UFC) 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings.*

UFC 4-010-01 establishes the minimum building antiterrorism standards for all DoD components. Mandatory DoD minimum antiterrorism standards for new and existing inhabited buildings are contained in UFC 4-010-01, Appendix B. Mandatory DoD minimum antiterrorism standards for expeditionary and temporary structures are contained in UFC 4-010-01, Appendix D. Additional recommended measures for new and existing inhabited buildings are contained in UFC 4-010-01, Appendix C.

Implementation of the mandatory standards is obligatory for all new construction, regardless of the funding source. The standards will be reviewed before any site planning or design is initiated.

Table 12-1 Sustainable Design Considerations/Opportunities	
Safety and Security Strategies	**Sustainable Design Considerations/Opportunities**
Access Control[a]	
Secure site perimeter.	Integrate with sustainable landscaping scheme.
Use barriers/berms to prevent passage of vehicles.	Use natural and/or environmentally friendly materials (e.g., trees, retention ponds, recycled-content planters, etc.).
Minimize public entrances into the building.	Integrate with daylighting scheme.
Secure vulnerable openings (e.g., doors, first floor windows).	Integrate with daylighting scheme.
Install electronic access systems (e.g., parking, elevators).	Use energy-efficient systems. Consider renewable and/or distributed energy resources.
Secure critical functions (e.g., IT, mechanical rooms).	Consider dedicated ventilation and/or exhaust systems.
Surveillance[a]	
Place windows and doors to allow for good visibility.	Integrate with daylighting scheme.
Avoid spaces that permit concealment.	Integrate with daylighting scheme.
Avoid blocking lines of sight with fencing and landscaping.	Integrate with landscaping and daylighting schemes.
Design lighting to reinforce natural surveillance.	Integrate with building automation and control systems. Use energy-efficient systems.
Install intrusion devices and video systems.	Integrate with building automation and control systems. Use energy-efficient lighting and controls. Consider renewable and/or distributed energy sources.
Blast Protection[a]	
Design structural systems to prevent or delay building collapse.	Integrate with passive solar design (e.g., Trombe walls). Use sustainable materials (e.g., fly-ash concrete, slag concrete, steel columns, etc.).
Use building configurations to better resist blast shock waves.	Integrate with passive solar design and daylighting scheme.
Maximize distances between parking and buildings.	Integrate with alternative transportation plans.
Size and locate windows with detonation points in mind.	Integrate with daylighting scheme.
Increase strength of exterior cladding and nonstructural elements.	Use sustainable materials. Consider thermal benefits of strengthened cladding options.
Avoid exterior ornamentation that can break away.	Integrate with sun control and shading devices.

Notes:

[a] From *Building Security Through Design: A Primer for Architects, Design Professionals, and their Clients* by The American Institute of Architects. Washington, DC: AIA, 2001, p. 15.

[b] From WBDG Safe—Ensure Occupant Safety & Health.

Source: *Balancing Security/Safety and Sustainability Objectives* by Richard Paradis and Bambi Tran, Steven Winter Associates, Inc.

Minimum standoff distances and separation for buildings are as follows:

- The minimum standoff distances and separation for new and existing buildings are found in Table B-1 of UFC 4-010-01.
- The minimum standoff distances and separation for expeditionary and temporary structures are found in Table D-1 of UFC 4-010-01.

The DoD minimum standards, when applicable, may be supplemented by more stringent force protection building standards to meet specific threats. Those additional requirements may be established by either standards for specific Combatant Commanders or based on Risk and/or Threat Analysis.

When the minimum standoff distances cannot be achieved because land is unavailable, the standards allow for building hardening to mitigate blast effects. Costs and requirements for building hardening will be addressed in the DoD Security Engineering Manual.

Additional guidance on applying the DoD Minimum Antiterrorism Standards for Buildings can be found in UFC 4-010-02, Design (FOUO): DoD Minimum Standoff Distances for Buildings. This document includes Tables 1 and 2, which identify the minimum standoff distances and separation for new and existing buildings and expeditionary and temporary structures. The last column of each table, titled "Applicable Explosive Weight," includes specific explosive weights in kilograms (pounds) of TNT, which makes these tables for official use only (FOUO).

Access to UFC 4-020-02 can be gained through the U. S. Army Corps of Engineers' Protective Design Center (PDC) web-based library. A user name and password are required. Site entry is restricted to U.S. Government agencies and their U.S. contractors. However, many of the publications listed on the site are approved for public release and can be found on the web at Publications of Headquarters, Corps of Engineers web page or on the web ProjNet Unified Facilities Criteria site.

Questions regarding the appropriate use, or access to UFC 4-010-02 shall be directed to Fort Hood Force Protection/Security personnel at 254-553-2782 or 254-288-6466.

12.1.2 Orientation of Buildings on a Site

The following will be given consideration during design charrette when determining the orientation of a building:

- Deny aggressors a clear "line of sight" to the facility from on or off the installation, where possible. Protect the facility against surveillance by locating the protected facility outside of the range or out of the view of vantage points.
- Protect against attack by selecting perimeter barriers to block sightlines such as obstruction screens, trees, or shrubs. Non-critical structures or other natural or manmade features can be used to block sightlines.
- Create "defensible space" by positioning facilities to permit building occupants and police to clearly monitor adjacent areas.
- Design vehicular flow to minimize vehicle bomb threats and avoid high-speed approach into any critical or vulnerable area.
- Avoid siting the facility adjacent to high surrounding terrain, which provides easy viewing of the facility from nearby non-military facilities.

12.2 LANDSCAPE CONSIDERATIONS

Landscaping guidelines for buildings shall not be ignored because of standoff distances. The landscape design shall enhance the overall attractiveness of the facility while still providing for or enhancing the objective level of security. The material used for landscaping must be consistent with the plant selection requirements of Section 10. All landscaping plans must be approved by the Fort Hood agronomist: 254-287-2885.

12.2.1 Vegetation

The presence of vegetation on an installation can have both beneficial and detrimental impacts on security. Proper selection and placement of trees and shrubs can provide visual screening without creating concealment for covert activity. A landscape plan shall provide visual screening without compromising antiterrorism measures. Plant material adjacent to buildings must allow building occupants to see out, but must not allow outside forces to

Thorn-bearing plants provide natural barriers to aggressors. Prickly ash (toothache tree or tickle-tongue) - a tall shrub that grows up to 15 feet and has many sharp spines, or the agarita - an evergreen with spiky leaves that grows 3 to 6 feet tall (see Section 10).

monitor interior activity. The landscape architect shall incorporate the following aspects into the design:

- Strategically locate trees and planters to prevent penetration of an attack vehicle into the secure area perimeter.
- Avoid conditions within 10 meters (33 feet) of inhabited structures that permit concealment of aggressors or obscure the view of objects or packages 150 millimeters (6 inches) in height from the view of security personnel. This results in the placement of shrubs and trees that are loose rather than dense in growth habit and possess multiple small stems rather than a single trunk that will obscure a 150-millimeter (6-inch) package.
- Vegetative groupings and earth sheltering berms provide inherent blast effect reduction from external blast forces.
- Plant material selection and placement shall minimize potential hiding places for bombs and aggressors. Use dense, thorn-bearing plant material to create natural barriers to deter aggressors.
- Provide vegetation screens to obscure play areas and outdoor recreation areas from off-installation view.
- Use trees to obscure sight lines of on-installation buildings from off-installation buildings.

12.2.2 Buffers and Landforms

Buffers and landforms use distance and natural slopes or grading to create barriers. These barriers can enhance the landscape while also providing protection. Berms and swales are landforms that, together with vegetation, can fulfill one of more of the following functions:

- Provide asset protection;
- Define boundaries of property or boundary limits;
- Provide a barrier to moving vehicles;
- Hinder pedestrian movement;

- Aid in visual screening, obstruct lines of sight; and/or
- Intercept projectiles.

In addition, berms and swales generally enhance the aesthetic quality of the landscape. Detailed design guidance is contained in Army Technical Manual (TM) 5-853-3/AFMAN 32-1071, Vol. 3, Security Engineering Final Design. **NOTE**: TM 5-853-3/AFMAN 32-1071 is a FOUO document and is not accessible on the Army Corps of Engineers publications website. A copy of the manual can be acquired by ordering it through your standard publications account. See Section 12.5 "References."

12.3 SITE AND STRUCTURAL ELEMENT CONSIDERATIONS

Site and structural elements include site furnishings (e.g., signs, trash containers), barriers, fences, walls, bollards, and jersey barriers. Elements can be used alone or in conjunction with other elements to achieve the desired level of security and impenetrability. It is required that when designing landscape enhancements that include security and force protection considerations, that the landscape architect work closely with the installation Force Protection or Physical Security Officer.

12.3.1 Fencing

Fences are used as protective measures against project-specific threats. They are most appropriately used to define boundaries and to deter penetration of a secure area. A fence will assist in controlling and screening authorized access to a secured area. Fencing type and material requirements as described in Section 11.3.2.7 shall be met unless security requirements deem otherwise.

Fences shall be designed to complement the physical appearance of adjacent buildings, structures, and gatehouses. The fencing layout shall be planned as an integral part of site and building plans. Open fencing can provide visual screening when combined with vine coverage, or with tightly spaced bars or rails. Plants with tall growth habits and/or large mature growth will be located well away from security fences.

Fences also serve the following purposes:

- As a platform for the Intrusion Detection System;
- As a screen against explosive projectiles;

- To direct pedestrians to the guardhouse area or secured entry point;
- To stop moving vehicles if they are reinforced to do so; and
- Establish clear zones along both sides of security fencing. Vegetation in the clear zone shall not exceed 4 inches in height (DoD 0-2000.12-H, *Protection of DoD Personnel and Activities Against Acts of Terrorism and Political Turbulence,* Appendix EE, Table EE-4. **NOTE:** This handbook is an FOUO publication. See Section 12.5 “References”).
- Chain-link security fence shall be a minimum of 7 feet high and contain 6 feet of chain link fence and three strands of barbed wire in accordance with UFGS-02821A Apr 04.

12.3.2 Lighting

Lighting systems for security operations provide illumination for visual and closed-circuit television (CCTV) surveillance of boundaries, sensitive inner areas, and entry points. When CCTV is used as part of security operations, the lighting system will be coordinated with the CCTV system. The specific installation environment and the intended use determines lighting system requirements. Often two or more types of lighting systems are used within a single area. Guidance on the use of security lighting may be obtained from Army Technical Manual (TM) 5-811-1, *Electrical Power Supply and Distribution*. Lighting type and material requirements discussed in Section 11.5.2 shall be met unless security requirements deem otherwise.

12.3.3 Berms and Barriers

Use of berms and barriers for force protection can fulfill one or more of the following functions:

- Define boundaries of property or boundary limits;
- Provide a barrier to moving vehicles;
- Hinder pedestrian movement;
- Intercept projectiles; and/or
- Obstruct lines of sight.

Berms or barriers used to block lines of sight or projectiles must be high enough to achieve those objectives or may be combined with landscaping or other construction elements. The use of recycled, inert, materials (e.g., concrete) shall be considered for berm foundation and barriers. Berm and barrier design shall be integrated into the landscape and built environment, complementing architectural style, colors, and materials. Unacceptable barrier materials include plastic, wood or recycled wood, metal, plastic or wooden slats woven into chain link fencing. Grading, drainage, and erosion control measures shall be built into the design of the structures. Berms and barriers shall be located and constructed considering ease of maintenance. Army detailed design guidance is contained in Army TM 5-853-3/Air Force Manual (AFMAN) 32-1071, Volume 3, *Security Engineering Final Design* (a FOUO document; see Section 12.5 “References”).

12.3.4 Walls

Walls can be designed to blend in with other site improvements to the point that their function as security barriers is camouflaged. Wall materials appropriate for security barriers include masonry and concrete. Selection of the appropriate wall material, color, and finish shall respond to adjacent architectural detailing, as well as conform to requirements and criteria outlined in Section 8.13 and Section 11.3.2.1 and 11.3.2.7. Walls used for visual screening shall be a minimum of 6 feet tall. The design of security walls can incorporate planters and seating, although the design and size of these embellishments will depend on security requirements for the wall. Walls built for standoff and to protect against vehicle approach shall be a minimum of 2 feet tall by 1 foot thick and backfilled.

12.3.5 Bollards and Jersey Barriers

Bollards and jersey barriers are primarily used to restrict vehicular access. When preventing vehicle movements, bollards/swing gates can be used to permit pedestrian access. Bollards shall be constructed of heavy gauge structural steel or cast concrete. Bollards constructed of wood are not acceptable for use on the installation. Provide removable bollards at secure locations needing emergency or service vehicular access. Bollards shall be used in service areas, to protect transformers and other utility boxes and meters. Plantings integrated with bollards can add additional protection and enhance the visual appearance of the bollard. In certain cases, large rocks, indigenous to the installation landscape, can be used in place of bollards, either individually or placed together as outcroppings. Bollard/swing gates requirements as described in Section 11.3.2.12 shall be met unless security requirements deem otherwise. Refer to technical supplement for guidance.

12.3.6 Signs and Containers

Designers shall balance the need for signs that identify, locate, and direct residents and support personnel to installation assets versus the need to discourage and frustrate hostile intelligence gathering and access. One method of achieving this balance is to direct people to a community support or information center to obtain directions. Sign requirements as described in Section 11.4.1 shall be met unless security requirements deem otherwise.

Place trash containers as far away from the facility as possible. Antiterrorism/force protection requirements restrict the location of dumpsters to a minimum of 10 meters (33 feet) from inhabited buildings and 25 meters (82 feet) from billeting and primary gathering areas (UFC 4-010-01, Table B-1). Where the standoff is not available, harden trash enclosures to mitigate direct blast effects and secondary fragment effects. Contact Force protection at 254-553-2782 or 288-6466 for more guidance.

12.3.7 Gates and Entrances (Access Control Points)

Installation entry points are key components in the force protection security program. The most effective entrances accommodate the functions of observation, detection, inspection, access control, and disablement of hostile personnel and vehicles while containing the vehicles and pedestrians until access is granted. These areas are one of the most important installation features in the creation of a sense of arrival for both installation personnel and visitors. It is important that these areas present a positive public image. Gate and entrance landscaping requirements as described in Section 10.5.3.2.1 shall be met unless security requirements deem otherwise.

12.3.8 Windows, Doors and Skylights

Antiterrorism and Force Protection requirements specify specific window, door, and skylight requirements. Contact Force Protection at 254-553-2782 or 288-6466 for more guidance.

12.3.9 Air Conditioning and Heating

Antiterrorism and Force Protection requirements specify specific HVAC to include emergency shut off and air intake requirements. Contact Force Protection at 254-553-2782 or 288-6466 for more guidance.

12.3.10 Mail Requirements

Antiterrorism and Force Protection requirements specify specific mailroom requirements. Contact Force Protection at 254-553-2782 or 288-6466 for more guidance.

12.3.11 Mass Notification

Antiterrorism and Force Protection requirements specify specific Mass Notification requirements. Contact Force Protection at 254-553-2782 or 288-6466 for more guidance.

The Headquarters, Department of the Army force protection standards for ACPs is found in UFC 4-022-01, *Security Engineering: Entry Control Facilities / Access Control Points* and The Army Standard for Access Control Points (ACPs). Access control point drawings can be downloaded from https://pdc.usace.army.mil/library/drawings/acp.

12.3.12 Physical Security Equipment

The Product Manager, Force Protection Systems (PM-FPS) under DoD Directive 3324.3 is assigned the mission of developing, fielding, and supporting physical security equipment throughout its life cycle for the Army, Joint Services, and other government agencies.

The DoD Directive 3324.3 assigns specific areas of responsibility which include: interior FPS, C2 systems, security lighting, force protection systems, tactical security equipment, barrier and systems, and interior and exterior robotics. Management functions include responsibility for research, development, acquisition, fielding, and logistics support of FPS except for those functions specifically assigned to other Services or to the Defense Threat Reduction Agency (DTRA). The PM-FPS homepage and the DA approved equipment Blank Purchase Agreements (BPAs) are listed below.

- Product Manager – Force Protection Systems (PM-FPS) Homepage.
- DA Approved FPS Equipment Blanket Purchase Agreements (BPAs).

For information on selecting and installing intrusion detection systems on the installation contact the Directorate of Emergency Services Physical Security Branch, Mr. Robin Riggs, (254) 287-1942.

12.4 ARMY STANDARDS

The cited Army Standards shall be met.

- **Americans with Disabilities Act Accessibility Guidelines** (http://www.access-board.gov/adaag/html/adaag.htm).
- **The Army Standard for Access Control Points** (http://www.mantech-mec.com/fme_web/IDG/0412%20Army%20STD%20for%20ACPs.pdf).
- **DoD Instruction 2000.16, *DoD Antiterrorism Standards*** (http://www.dtic.mil/whs/directives/corres/html/200016.htm).
- **NFPA National Fire Protection Codes** (http://www.nfpa.org/Codes/NFPA_Codes_and_Standards/List_of_NFPA_documents/list_of_folders.asp)
- **Unified Facilities Criteria (UFC) 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*** (http://www.acq.osd.mil/ie/irm/irm_library/UFC4_010_01.pdf).
- **UFC 4-022-01, *Security Engineering: Entry Control Facilities / Access Control Points*** (http://www.wbdg.org/ccb/DOD/UFC/ufc_4_022_01.pdf).
- **UFC 4-010-02.** This document is an FOUO publication. Users may contact Fort Hood force protection/security personnel at 254-287-4915.
- **Uniform Federal Accessibility Standards** (http://www.access-board.gov/ufas/ufas-html/ufas.htm).

12.5 REFERENCES

The following references are provided for guidance.

- Access control point drawings available at https://pdc.usace.army.mil/library/drawings/acp.
- Army Regulation (AR) 525-13, The Army Force Protection Program (available only through the Army Knowledge Online web portal at https://www.us.army.mil/portal/portal_home.jhtml).
- DoD Handbook 0-2000.12-H, *Protection of DoD Personnel and Activities Against Acts of Terrorism and Political Turbulence*, February 1993. This handbook is an FOUO publication. Users may contact the Point of Contact posted at

http://www.dtic.mil/whs/directives/corres/html/o200012h.htm to obtain a copy of the Handbook.

- Product Manager - Physical Security Equipment Homepage at http://www.pmpse.org/.
- DA-approved Personal Security Equipment Blank Purchase Agreements: http://www.cecomacw.army.mil/Projects/CECOM/Homepa~1.nsf/0/35e9b890b2bb945f852569b4007776fd?OpenDocument.
- Army Technical Manual/Air Force Manual series TM 5-853/AFMAN 32-1071, *Security Engineering*, three-volume series. Volumes 2 and 3 are FOUO and are not available on the Army Corps of Engineers publications website. A copy of the manuals can be acquired via your standard publications account. The three volumes cover project development, concept design, and final design, respectively.
- TM 5-811-1, *Electrical Power Supply and Distribution* available at http://www.usace.army.mil/inet/usace-docs/armytm/tm5-811-1/.
- U.S. Air Force, Installation Force Protection Guide available at http://www.wbdg.org/ccb/AF/AFDG/afinstal.pdf. This document contains information on installation planning, engineering design, and construction techniques that will preclude or minimize the effect of a terrorist attack.
- UFC 2-600-01*, Installation Design,* Chapter 12 available at http://www.hnd.usace.army.mil/techinfo/UFC/UFC2-600-01/Chap12.pdf.
- UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings* available at http://www.acq.osd.mil/ie/irm/irm_library/UFC4_010_01.pdf.
- UFC 4-010-02, *DoD Minimum Standoff Distances for Buildings, a FOUO document,* available on the password-protected site at https://pdmcx.pecp1.nwo.usace.army.mil/library/ufc/4-010/index.php. To enter the site you must access the site from either a ".mil" or ".gov" address. Questions regarding the appropriate use, or access to UFC 4-010-02 shall be directed to Fort Hood Force Protection at 254-553-2782.

- UFC 4-021-01, *Mass Notification Systems,* available at http://www.simplexgrinnell.com/files/gsa/UFC4-021-01.pdf.

The construction process can have a significant impact on environmental resources. Sustainable construction practices can markedly reduce site disturbance and water quality impacts, the quantity of waste sent to landfills and the use of natural resources during construction. It can also minimize the prospect of adverse indoor air quality in the finished building. The standards identified in this section will help you meet Fort Hood's 25-Year Sustainable Goals to (1) plan, design, construct, and maintain all infrastructure and energy systems to be sustainable and secure, and (2) to minimize waste and environmental impact.

Typically, construction practices involve the clearing and disturbance of the building site's existing natural resources and features (e.g., native vegetation and wildlife, natural drainage systems, and topography) to replace them with artificial systems, such as non-native vegetation and artificial drainage structures. Construction practices at Fort Hood produce approximately 760 tons of asphalt per month, 1,400 tons of concrete per month, 140 tons of masonry and rock per month, and 2,700 tons of soil per month. Emissions from new construction materials, as well as dust, particulates, and other airborne contaminants generated during the construction process, are believed to be a cause of health problems for workers and future building occupants.

Disposing of C&D debris in landfills is both economically and environmentally costly, wasting natural resources and valuable landfill space. Fort Hood is committed to the recycling/salvaging of C&D debris.

The standards contained in this section pertain to all construction resulting in any land disturbance within the boundaries of Fort Hood. Land disturbance is defined as clearing, grading, excavating, or similar activities that disturb or expose soil.

Definitions for Key Terms Used in this Section

Small Construction Activity. Construction activity that results in land disturbance equal to or greater than 1 acre and less than 5 acres of land. Small construction activity also includes the disturbance of less than 1 acre of total land area that is part of a larger common plan of development if the larger common plan will ultimately disturb equal to or greater than 1 acre and less than 5 acres of land (Texas Pollutant Discharge Elimination System [TPDES] General Permit TXR150000, Part I. Definitions). Small construction activity does not include:

1. Routine maintenance that is performed to maintain the original line and grade, hydraulic capacity, and original purpose of a ditch, channel, or other similar stormwater conveyance.

2. The routine grading of existing dirt roads, asphalt overlays of existing roads, the routine clearing of existing right-of-ways, and similar maintenance activities.

Large Construction Activity. Construction activity that results in land disturbance equal to or greater than 5 acres of land. Large construction activity also includes land disturbance of less than 5 acres of total land area that is part of a larger common plan of development if the larger common plan will ultimately disturb equal to or greater than 5 acres of land (TPDES General Permit TXR150000, Part I. Definitions). Large construction activity does not include:

1. Routine maintenance that is performed to maintain the original line and grade, hydraulic capacity, and original purpose of a ditch, channel, or other similar stormwater conveyances.

2. The routine grading of existing dirt roads, asphalt overlays of existing roads, the routine clearing of existing right-of-ways, and similar maintenance activities.

Other Construction Activity. Construction activities that are less than 1 acre of land disturbance are requested to provide erosion and sediment controls where feasible and needed to protect Fort Hood's MS4 and the environment.

Construction Site Operator. The person or persons associated with a large or small construction activity that meets either of the following two criteria:

1. The person or persons have operational control over construction plans and specifications to the extent necessary to meet the requirements and conditions of the TPDES Construction General Permit (TPDES General Permit TXR150000, Part I. Definitions).

2. The person or persons have day-to-day operational control of those activities at a construction site that are necessary to ensure compliance with a stormwater pollution prevention plan (SWPPP) for the site or other permit conditions (i.e., they are authorized to direct workers at a site to carry out activities required by the SWPPP or comply with other permit conditions; TPDES General Permit TXR150000, Part I. Definitions).

Sediment from erosion is a major pollutant of our nation's surface waters (rivers, streams, creeks, lakes, etc.). Excess sediment in surface waters causes flooding, disturbs and even destroys aquatic life and habitats. The majority of this excess sediment is from construction sites. When the land is disturbed and soil is exposed it is washed away during storm events through the process of erosion, resulting in sedimentation of surface waters. Other pollutants on the construction site such as fuel spills, oil spills, and/or other hazardous materials lacking proper storage can be carried with the sediment and water and deposited in our surface waters.

The State of Texas through the Environmental Protection Agency's (EPA) guidance has developed a Construction General Permit, TXR150000, to control and eliminate excess sediment and other pollutants from leaving the construction site. Fort Hood's criteria for construction site erosion, sediment, and other pollutant controls are described below.

These criteria pertain to all construction resulting in any land disturbance within the boundaries of Fort Hood. Land disturbance is defined as clearing, grading, excavating, or similar activities that disturb or expose soil.

Definitions for Key Terms Used in this Section

Small Construction Activity. Construction activity that results in land disturbance equal to or greater than 1 acre and less than 5 acres of land. Small construction activity also includes the disturbance of less than 1 acre of total land area that is part of a larger common plan of development

if the larger common plan will ultimately disturb equal to or greater than 1 acre and less than 5 acres of land (Texas Pollutant Discharge Elimination System [TPDES] General Permit TXR150000, Part I. Definitions). Small construction activity does not include:

1) Routine maintenance that is performed to maintain the original line and grade, hydraulic capacity, and original purpose of a ditch, channel, or other similar stormwater conveyance.

2) The routine grading of existing dirt roads, asphalt overlays of existing roads, the routine clearing of existing right-of-ways, and similar maintenance activities.

Large Construction Activity. Construction activity that results in land disturbance equal to or greater than 5 acres of land. Large construction activity also includes land disturbance of less than 5 acres of total land area that is part of a larger common plan of development if the larger common plan will ultimately disturb equal to or greater than 5 acres of land (TPDES General Permit TXR150000, Part I. Definitions). Large construction activity does not include:

1) Routine maintenance that is performed to maintain the original line and grade, hydraulic capacity, and original purpose of a ditch, channel, or other similar stormwater conveyances.

2) The routine grading of existing dirt roads, asphalt overlays of existing roads, the routine clearing of existing right-of-ways, and similar maintenance activities.

Other Construction Activity. Construction activities that are less than 1 acre of land disturbance are requested to provide erosion and sediment controls where feasible and needed to protect Fort Hood's MS4 and the environment.

Construction Site Operator. The person or persons associated with a large or small construction activity that meets either of the following two criteria:

1) The person or persons have operational control over construction plans and specifications to the extent necessary to meet the requirements and conditions of the TPDES Construction General Permit (TPDES General Permit TXR150000, Part I. Definitions).

2) The person or persons have day-to-day operational control of those activities at a construction site that are necessary to ensure compliance with a stormwater pollution prevention plan (SWPPP) for the site or other permit conditions (i.e., they are authorized to

direct workers at a site to carry out activities required by the SWPPP or comply with other permit conditions; TPDES General Permit TXR150000, Part I. Definitions).

13.1 CONSTRUCTION PHASING

Fort Hood requires construction phasing for site disturbance greater than 5 acres. Phasing reduces the amount of land disturbance at any given time and should be used in conjunction with the other site-related construction standards identified in this section. Key principles of phasing are to establish construction buffers, grade/excavate only the area planned for immediate construction, and inspect and maintain all controls every seven days. Properly maintained controls and barriers will improve sediment settling, which will decrease negative environmental effects, including erosion and flooding, while protecting surface water quality for recreation and as a drinking source. Phasing plans may be identified during planning charrettes.

The following construction phasing is preferred for construction activities on Fort Hood; will assist in successfully complying with the TPDES Construction General Permit TXR150000; and should be addressed in the site-specific Stormwater Pollution Prevention Plan (SWPPP), see Section 13.2.1 for more information:

1) **Pre-construction Actions.** This includes protecting existing vegetation and trees, providing a natural vegetated buffer along water bodies, including along tributaries of creeks and streams, and preserving natural vegetation on the site perimeter, where practicable.

2) **Perimeter Sediment Control Measures.** Install perimeter protection which includes the installation of any sediment basins or traps.

3) **Construction Access.** Install a stabilized construction entrance. The entrance can be made of any material that will vibrate vehicles when leaving the construction site.

4) **Runoff Control Measures.** Install for concentrated flows.

5) **Land Clearing and Grading.** Phase grading as site progresses, clear and grade where needed, but not entire site at one time. Stockpile existing topsoil for reuse.

6) **Surface Stabilization and Erosion Control.** Temporary and permanent stabilization should occur immediately on all disturbed areas.

7) Sediment Controls. Install for inlets and any other areas.

8) Building Construction. Erosion and sediment controls should remain in place where needed for the duration of construction until final stabilization requirements are met.

9) Landscaping and Final Stabilization. Phase final stabilization on final graded areas as the project progresses, rather than waiting for entire site completion. Once final stabilization requirements have been met, temporary controls may be removed.

Ensure the SWPPP is used as a living/working document where changes and amendments of best management practices (BMPs), construction operation, inspection results, etc. are annotated in the SWPPP and on the detailed site map where applicable. (TPDES General Permit TXR150000, Part III., Section C., 1., (c), Section E., and Section F., 8., (c)).

13.2 EROSION AND SEDIMENT CONTROLS FOR CONSTRUCTION

Construction activity has the potential to severely impact natural systems due to effects such as sedimentation, dust, compaction, and chemical runoff. When the land is disturbed and soil is exposed it is washed away during storm events through the process of erosion, resulting in sedimentation of surface waters. Other pollutants on the construction site such as fuel spills, oil spills, and/or other hazardous materials lacking proper storage can be carried with the sediment and water and deposited in our surface waters. To minimize these impacts to surface waters (rivers, streams, creeks, lakes, etc.) and the environment, Fort Hood has developed a series of erosion and sediment guidelines including required elements for all construction activity as well as recommended controls for use during construction. These controls pertain to all construction resulting in any land disturbance within the boundaries of Fort Hood. Fort Hood's criteria for construction site erosion, sediment, and other pollutant controls are described below.

13.2.1 Texas Pollutant Discharge Elimination System CONSTRUCTION GENERAL PERMIT TXR150000

The State of Texas through the Environmental Protection Agency's (EPA) guidance has developed a Construction General Permit, TXR150000, to control and eliminate excess sediment and other pollutants from leaving the construction site. If a construction activity results in land disturbance of one (1) acre or more, then the construction site operator(s) is (are) required to apply for authorization

under the TCEQ, Texas Pollutant Discharge Elimination Systems (TPDES), General Permit No. TXR 150000, General Permit to Discharge Waste.

The operator(s) will provide a copy of the following documents, as applicable, to the Fort Hood Directorate of Public Works Environmental Division (FHDPW-ENV):

1. **For Large Construction Activity.** Notice of Intent (NOI) at least two days prior to commencement of construction activities (TPDES General Permit TXR150000, Part II.D.3).

2. **For Small Construction Activity.** Construction Site Notice at least two days prior to commencement of construction activities (TPDES General Permit TXR150000, Part II.D.2).

3. **Stormwater Pollution Prevention Plan (SWPPP).** The SWPPP functions as a guide for implementing onsite erosion and sediment control practices. A SWPPP will be developed for both large and small construction activities and will be submitted for review as soon as possible, preferably two weeks in advance, but at least two days prior to commencing construction activities.

The NOI or Construction Site Notice and SWPPP submission may be made through the weekly FHDPW-PPD Project Review Board, or directly to FHDPW-ENV at the following address:

III Corps & Fort Hood
Attn: IMSW-HOD-PWE
Bldg. 4219, 77th Street & Warehouse Avenue
Fort Hood, TX 76544-5028
Phone: (254) 287-6499

The Environmental Division office will review the SWPPP and return comments. All comments from the Environmental Division office should be addressed prior to the commencement of construction activities in order to avoid the need to make major changes to erosion and sediment controls after installation.

Ensure the SWPPP is used as a living/working document where changes and amendments of best management practices (BMPs), construction operation, inspection results, etc. are annotated in the SWPPP and on the detailed site map where applicable. (TPDES General Permit TXR150000, Part III., Section C., 1., (c), Section E., and Section F., 8., (c)).

13.2.2 RAINY SEASON GUIDANCE

1) Minimize the length of time that soil is exposed.

2) Reduce the total area of exposed soil during winter months and rainy seasons.

3) Protect critical areas such as drainage ditches or channels, streams, and natural watercourses.

4) Protect outlets by using energy dissipaters such as riprap that is sized according to the exit velocity and apron length.

5) Stabilize exposed areas expediently.

Courtesy of TxDOT.

Rock check dam pooling water and allowing sediments to settle out of stormwater runoff.

13.2.3 RUNOFF CONTROLS

Runoff should be evaluated both on the perimeter and internal areas of the site. Perimeter evaluation should include any type of run-on, runoff from the site, and inlet outfalls from the site. Internal areas should be evaluated for diverting and conveying runoff to temporary or permanent control areas.

The following runoff controls are preferred by Fort Hood:

1. Diversion dikes or silt fence used to direct runoff away from disturbed areas.

2. Sediment basin or traps to reduce discharge of sediment and other pollutants from the site.

3. Vegetated or grass swales, reinforced with turf reinforcement mats or riprap on the bottom of the channel.

4. Rock check dams, compost or mulch berms, and triangular silt dikes used in series in drainage channels.

5. Slope drains where runoff is conveyed to the slope drain to prevent slope erosion with an energy dissipater installed at the drain outlet.

6. If hydraulically applied blankets are used, the material should be applied according to the manufacturer's application rate.

7. Flared culvert end sections that spreads concentrated flow and slows the flow; prevents erosion at inlets and outlets.

8. Outlet protection.

13.2.4 Erosion and Sediment Controls

Erosion and sediment controls should be chosen based on site characteristics. Slope, soil type, potential runoff volume, and size of the construction area are a few of the criteria used for choosing the number and type of control. The basic approach to erosion and sediment control at Fort Hood is to identify drainage zones on the site, then prepare a site-specific SWPPP for each project. Additional rules of thumb include preservation of existing vegetation where possible, diversion of upland water around bare areas, swift coverage of bare areas, leaving vegetation buffers along waterways (minimum 50 feet.; see Section 7.3.2), and installing appropriate erosion and sediment controls.

Fugitive dust control measures are required for use during construction or other land disturbance activities for any disturbed site creating dust, no matter the size. Temporary measures approved for use at Fort Hood include windbreaks barriers, spray-on adhesives, tillage, chemical treatment, vegetation, water spraying, erosion control socks, or other methods approved by the Environmental Division, DPW. Additional information on the implementation of these measures can be found in the Storm Water Management Fact Sheet "**Dust Control**" at http://www.epa.gov/owm/mtb/dustctr.pdf.

The use of erosion and sediments controls is required by federal, state, and Fort Hood regulations. The Department of Transportation (TxDOT) Storm Water Management Guidelines for Construction Activities Manual (King et al. 2002) list many vegetation, erosion, and sediment controls practicable for Fort Hood. The EPA also has published a list of Best Management Practices (BMPS) available at the following website: http://cfpub.epa.gov.

Approval of erosion and sediment controls for construction projects shall come from the Water Program Manager, (254) 287-8712. For additional information on erosion and sediment control, please contact Fort Hood DPW, Environmental Division at (254) 287-6499.

Courtesy of TxDOT

Stabilized construction exit.

Erosion Control Compost

This erosion control measure is recommended for us at Fort Hood. It is a compost and mulch (50-50) mix that contains an approved seed mixture. The mixture is applied over bare ground 1" to 2" thick. This compost can be used on any bare areas and can be used with or without topsoil.

Retention blankets paired with silt fence to stabilize a slope.

13.2.4.1 Erosion Control

Erosion control is the first line of defense because if prevents the soil from moving and thus becoming sediment-laden runoff. Designing for erosion controls should take the following into account:

- Identifying critical areas of the site;
- Identifying the timing of soil disturbing activities; and
- Evaluating the erosion potential.

The use of vegetation such as grasses, forbs, shrubs, or trees is the most fundamental method of erosion control. A vegetative cover reduces erosion by protecting the soil surface from raindrop impacts, holding soil in place, increasing soil porosity and permeability, and slowing the velocity of water.

Fort Hood prefers establishing a vegetative cover to control erosion on unpaved surfaces. The following are interim erosion controls to be used on Fort Hood during the establishment of vegetation:

1) Preserving existing vegetation where practicable until active construction occurs in that area. This existing vegetation acts as vegetative buffers or strips to aid in the removal of suspended solids in sheet flows. This is especially preferred for construction activities near water bodies, preferably 50 feet in width.

2) Erosion control compost (ECC), flexible growth medium (FGM), rolled erosion control products (RECPs), or similar controls.

3) Soil roughening using a dozer (blade up) to track walk up and down slopes so the ridges are perpendicular to the direction of the water flow. A roughened slope slows water velocity and increases infiltration.

4) Stockpile existing vegetation (chipped) and topsoil to be used for final stabilization, which promotes native re-growth. Also, temporarily seeding the stockpile to reduce erosion.

If using mulch or rock/rip as part of your projects erosion and sediment control efforts, some of these materials may be available through the Solid Waste Contract Office. Contact the Solid Waste Program Manager for details (254) 287-9184 or (254) 287-6499.

Vegetation Establishment. For vegetation establishment, use the following guidelines:

1) Use sod where practicable. For areas that will not receive sod, all areas of disturbed ground must be seeded. Fort Hood requires the use of only native grass species for seeding.

2) Properly prepare site for seeding by applying amendments such as compost as needed, and ensuring the seedbed is firm but not compact, and the top 3 inches of soil is loose and moist. Use native seed mixtures. Contact the Fort Hood Agronomist at 254-287-2885 or review Appendix I of the Fort Hood Installation Design Guide for a list of approved vegetation to be used on Fort Hood.

3) Conduct soil tests to determine the need for fertilizers. Use timed-release nitrogen fertilizer products, if needed, for vegetation establishment.

4) Seeding should be planted first before installation of certain controls such as RECPs, but should be mixed in and applied together with other controls such as ECC or FGM.

5) If using mulch, ensure the proper amount (tons per acre [tons/ac) of mulch is calculated and applied for effective results.

    a) Typically, the standard application rate of straw or hay mulch is 1.5 to 2.0 tons/ac at 80% to 100% ground coverage.

    b) The standard application rate of hydraulic mulches is 1.0 to 1.5 tons/ac at 80% to 100% ground coverage.

6) If straw or hay mulch is used, ensure straw or hay is crimped, bound, or tackified to the soil.

7) Mulch cover must remain and be maintained until sufficient vegetation is established.

8) For slopes that are steeper than 3:1 where the seedbed cannot be properly prepared, recommend hydraulic or pneumatic broadcast of seed mixed in with erosion control compost, FGM, or a similar product.

9) RECPs can be used rather than mulch in some situations. RECPs increase infiltration, conserve soil moisture, and keep the seed in place. The RECP should outlast the time needed for the establishment of the vegetation and can either be organic or inorganic (i.e., jute

netting, straw blanket, excelsior wood fiber blanket, polypropylene and nylon blanket, straw-coconut fiber blanket, coconut fiber blanket, etc.).

10) Organic RECPs should be used on slopes when establishing vegetation and along with the following concepts:

    a) Prepare and plant seed before RECP installation.

    b) "Walk" the material down the hill to maintain good contact between the RECP and the soil.

    c) Overlap material.

    d) Use sufficient staples.

11) Drainage channels should use either two types of RECPs: Erosion Control Blanket (ECB) or Turf Reinforcement Mat (TRM). The ECB or TRM should be chosen based on hydraulic design and type of vegetation to be establishment in the area. Recommend planting seed, then applying hay mulch at a rate of 1.0 tons/ac before installing a TRM.

12) Irrespective of other, general guidance in this document, it is usually best to follow the manufacturer's instructions when using any products for erosion or sediment control.

13.2.4.2 SEDIMENT CONTROLS

Sediment controls are the second defense for controlling sediment that has already been detached and carried by water. Sediment controls such as temporary barriers, inlet protection, and construction entrances typically filter or pond the sediment-laden runoff in order for the sediment to settle out of suspension.

The following lists examples of sediment controls preferred by Fort Hood:

1) Sediment basins that serve 10 or more acres of land disturbance or sediment traps for areas serving less than 10 acres. (TPDES Construction General Permit, TXR150000, Part III, Section F., 3. Structural Control Practices, (a) & (b), pg. 24-25). Upon completion of a project, sediment basins can then serve as a post-construction permanent stormwater control, or may be deconstructed if no longer needed.

2) Stabilized construction entrances at least 50 feet in length, where needed.

3) Mulch or compost berms and socks.

4) Silt fence installed using the static slicing method and using the design idea of J-Hooks or "Smiles" which ponds the water to allow sediment to settle. It is generally not recommended to use silt fence in concentrated flows, such as drainage channels. Limit drainage area to 100 square feet per linear foot of silt fence. View the following websites for illustrations of the J-Hook design and the static slicing method, respectively: http://www.cascade.ab.ca/SiltFence.pdf.

5) Fiber rolls on slopes, 30 to 40 feet apart and anchored securely.

6) Inlet protection using masonry blocks with geotextiles and gravel, or silt fence, or fiber rolls.

13.2.5 POST CONSTRUCTION CONTROLS

Post-construction stormwater controls are intended to control stormwater at the source by infiltration, storage, and detention utilizing Low Impact Development (LID) practices. The following post-construction stormwater controls are preferred at Fort Hood:

1. Vegetated drainage swales.
2. Bioretention in parking areas.
3. Porous pavement, pavers, or similar pervious material for emergency vehicle lanes, sidewalks, or other appropriate areas.
4. Roof gutters that direct runoff to pervious areas.
5. Vegetated buffer along water bodies.
6. Xeriscaping.
7. Conservation of existing vegetation.

13.2.6 OTHER CONTROLS

In addition to the potential discharge of sediment from the construction site, other pollutants from the site require controls. The following are Fort Hood requirements regarding other controls on a construction site:

1. All fuel tanks will have secondary containment.
2. Use drip pans or pads when fueling vehicles.
3. Review, understand, and follow the requirements of FH Regulation 200-10 Spill Prevention Control and Countermeasure Plan.
4. Ensure construction waste is centralized on the site and not leaving the site.
5. Practice good housekeeping when storing construction materials.
6. Ensure proper labeling, storage, and maintenance of any hazardous material stored on site.
7. No vehicle cleaning onsite.
8. Contain concrete washout areas so runoff does not leave the site.
9. Do not pave/asphalt within 72 hours of rain.

13.3 PROTECTING AIR QUALITY

13.3.1 Indoor Air Quality

Indoor air quality (IAQ) problems can be caused by construction-related activities, including (1) dust created by the disturbance of building materials and systems during renovation or demolition; (2) emissions of volatile organic compounds (VOCs) from materials and products; or (3) emissions of combustibles and volatile organic compounds (VOCs) from construction equipment or construction processes. IAQ contaminants can move through a building in a variety of ways:

- Through the heating, ventilation, and air conditioning (HVAC) systems (from both the interior and exterior of the building);
- Through pressurization differentials in the interior spaces of the building; and
- Via workers' clothing, where VOCs and combustibles can settle and be released in other sections of the building.

Residual building contamination can continue to impact indoor air quality over the lifetime of the building, affecting occupants' health and productivity. Therefore, Fort Hood requires an **IAQ Management Plan** to be developed that addresses protection of the ventilation systems components during construction and cleanup of contaminated components after construction is complete. This type of plan does not have to be complex. Pest control measures for construction, as discussed in Section 8.15 and 10.9.6, can also be included in the plan.

Photo: Warren Gretz, ©DOE/NRE.

Building construction processes invariably include activities that contaminate the building during construction. HVAC systems are especially prone to contamination from particulate matter generated during construction activities.

As applicable to the project, the following control measures should be included in the IAQ Management Plan:

- **HVAC Protection.** Shut down or isolate the return side of the HVAC system during heavy construction or demolition. If air-handling units must be used during construction, filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 must be used at each return air grill.
- **Source Control.** Specify low- or no-emitting materials. See Section 8.12.4.3.
- **Pathway Interruption.** Isolate work areas, ventilate with 100% outside air, or use pressure differentials to prevent contaminated air from work areas from entering clean areas.
- **Housekeeping.** Protect stored on-site or installed absorptive materials from moisture damage. Clean HVAC components such as coils, air filters, and fans before performing testing and balancing procedures.

- **Scheduling.** Specify construction sequencing to install absorptive materials after the prescribed dry or cure time of wet finishes to reduce absorption of VOCs by porous materials.

- **Flush-out.** After construction ends and prior to occupancy, conduct a minimum two-week building flush-out with new MERV 13 filtration media at 100% outside air. After the flush-out, replace the filtration media with new MERV 13 filtration media except for the filters that are solely processing outside air.

- **IAQ Testing.** Conduct a baseline IAQ testing procedure consistent with the EPA's current "Testing for Indoor Air Quality, Baseline IAQ, and Materials, Section 01445."

13.3.2 Outdoor Air Quality

Protecting outdoor air quality through the control of fugitive dust is discussed in Section 13.1.

Before any actual work is begun, any person who plans to construct any new facility or to engage in the modification of any existing facility which may emit air contaminants into the air must follow the requirements outlined in 30 TAC Rule 116.110. Projects should include costs for permit application preparation and associated fees. For more information or a fact sheet for air quality permitting, please contact (254) 287-8714.

13.4 SCHEDULED MAINTENANCE, START-UP, AND SHUTDOWN ACTIVITIES FOR EMISSION.

An emissions event is any unscheduled accidental release of emissions or excess opacity (smoke) from an emissions point above a permitted limit or reportable quantity (RQ) as defined in 30 TAC §101.1. If an emission event was to occur, Fort Hood must report the incident to the Texas Commission on Environmental Quality (TCEQ) Waco Region 9 office and all appropriate local air pollution control agencies within 24 hours as required by 30 Texas Administrative Code (TAC) §101.201. Upon discovery of an unauthorized release of emissions or opacity, the DPW Environmental Office Air Program shall be notified at (254) 287-8714 so that the appropriate reporting can be done.

Alternatively, if unauthorized emissions or excess opacity are expected in the case of scheduled maintenance, startup, or shutdown activities (SMSSA), the owner or operator of the facility shall notify the DPW Environmental Office at least 10 days prior to any SMSSA. The DPW Environmental Office will then notify the TCEQ Waco Region 9 office and all appropriate local air pollution control agencies. For

activities that are expected to exceed a RQ for SMSSA, the owner or operator of the facility must provide notice at least 10 days in advance and a final report after the activity has taken place as required by 30 TAC §101.211. The notice or final report must include the information required in 30 TAC §101.211 and verification that the actual unauthorized emissions from the activity do not exceed the emissions estimates submitted in the initial notification. For activities with unauthorized emissions that are not expected to, and do not, exceed a RQ, the event must be recorded as required by 30 TAC 101.211. Expected excess opacity events as described in 30 TAC §101.201(e) (relating to Emissions Event Reporting and Recordkeeping Requirements) resulting from SMSSA require prior notice and must be recorded and reported in accordance with 30 TAC §101.211. Any unauthorized emission or opacity events shall be reported to the Fort Hood Air Program Manager at (254) 287-8714.

13.5 CONSTRUCTION AND DEMOLITION REQUIREMENTS

13.5.1 General Construction

Contractor Staging Area. The contractor's staging area will be within the contract grading limits. Proposed staging areas and concrete plant sites outside the grading limits will be approved prior to indicating the location in the bid documents. If the contractor requires a staging area outside the grading limits or in conjunction with renovation of existing facilities, a request showing the limit of the staging area must be submitted for approval prior to use of such area. If the project is in a highly visible area, the staging and storage areas shall be fended and screened. All staging areas near residential areas shall be fended and locked during non-work hours. Contractor shall have an emergency point of contact (name and phone number) placed at the entrance to there yard.

Temporary Utilities. The contractor shall submit a drawing indicating the location of each temporary electrical, gas, and water meter at each construction site to the Utilities Sales Clerk located in Building 4619, Energy Group.

Demolition Phasing. Where demolition of multiple building construction requires phasing, the phasing shall be established prior to and published for advance final review.

For additional information related to construction requirements for the following, contact the DPW.

As of 2004/2005, Fort Hood generated approximately 10,000 tons per month of C&D waste, a large portion of which is inert material that can be crushed and reused for projects such as road base, riprap, security berms, and fill for surface management units.

13.6 WASTE MANAGEMENT AND DISPOSAL

The management of used product and regulated waste on Fort Hood is the responsibility of the DPW Classification Unit (CU). Waste items typically managed and coordinated by the CU include hazardous and universal waste, TASC waste (i.e. PCBs, asbestos), liquid and dry non-hazardous waste that cannot be disposed of in the Fort Hood Landfill, and other non-hazardous waste that can be received at the landfill. Turn-in of these items is by appointment only and are conducted in accordance with the standards in Letter of Instruction (LOI) for the DPW Classification Unit.

Contractors working on Fort Hood may choose to dispose of their Fort Hood generated wastes following all applicable federal, state, and local regulations by 1.) Using a non-installation waste disposal facility or 2.) Using the Fort Hood Municipal Landfill. Appropriate identification and disposal of wastes are the responsibility of the contractor.

13.6.1 Construction Waste Management Plan

A plan must be established before proceeding with any projects generating a large quantity of waste. As part of the plan, Fort Hood requires the recycling and/or salvaging of C&D waste. The contractor will specify in the plan the type of material to be recycled or salvaged and its volume and/or weight. The plan and specific details for recycling and salvaging must be submitted to, and must receive approval from, the Solid Waste Program Manager: 254-287-9184 or 254-287-6499. The need for a Construction Waste Management Plan shall be established during the initial planning charrettes for any project.

Requirements that mandate the Construction Waste Management Plan are:

- UFGS Specification 01355A, *Environmental Protection*
- Residential Community Initiative – Environmental Protection Plan, Waste Management Plan, Appendix A; and
- Job Order Contracts- Special Projects Procedures for Fort Hood

For additional information on these requirements contact: 254 -287-9184.

In general, the plan should cover (1) recycling, recovery, and deconstruction of the existing facility; (2) recycling of construction waste, including site excavated soils and vegetation; and (3) disposing of hazardous waste. The plan should address conditions for use of Fort Hood landfill and Fort Hood's Inert Material Management Unit near the landfill. Inert material includes, but is not limited to, stone, concrete, masonry, clean fill, and asphalt).

Fort Hood's Environmental Standard Operating Procedures that detail the use of the Inert Material Management Unit are provided in *Use of Fort Hood's Inert Material Management Unit (IMMU) (also known as "the rubble pile")*. All inert material (concrete, asphalt, clean fill, rock and masonry) removed as the result of demolition, construction or site improvements shall be transported to the Inert Material Management Unit (IMMU) (next to the Fort Hood municipal solid waste landfill). Alternate sites can be identified and approved on a case by case basis with coordination through DPW-Environmental Division. For information about these procedures, contact 254-287-9184.

Fort Hood actively partners with Habitat for Humanity in the recycling of building materials. Alternatives to conventional demolition and landfilling waste have proven to reduce solid waste volume and avoid costs for landfill tipping fees.

Adherence to the waste management plan will become part of the demolition/construction contractor agreement. A successful plan does not need to be complicated to be effective but should include the following information:

- **Recycling, recovery, and deconstruction.**

  1. Include procedures for assessing building waste for salvaging and recycling potential.
  2. Provide an allotted time period for removal of salvageable and recycling items.
  3. Identify designated on-site areas with separate bins that are prominently labeled for each material.

- **Reducing and recycling of construction/packaging waste.**

  1. Identify procedures for the reuse of site materials, such as top soil and land-clearing debris, which can be shredded for mulch. If land-clearing debris must be disposed, the Fort Hood compost area should be used.
  2. Establish procedures for eliminating the ordering of excess construction materials and for returning excess or unused material to suppliers.

3. Identify procedures and staging areas on-site for packaging that needs to be returned to the vendor/manufacturer. Identify a separate, specific area for construction waste recycling. Identify who is responsible for monitoring the construction site to verify that packaging and construction waste is appropriately recycled.

4. Prohibit contractor from dumping any construction waste on site except for inert material such as clean soil, sand, sod, rock, concrete, masonry, brick, and asphalt.

13.6.2 Waste Reduction and Recycling

UFC 1-900-01, *Selection of Methods for the Reduction, Reuse, and Recycling of Demolition Waste*, provides guidance for the recovery and recycling of building demolition waste. The intent of the UFC is to assist DoD facilities in determining the most feasible method to reduce the amount of waste transported to landfills. A decision matrix to assist personnel in evaluating alternatives (i.e., recycling, recovery, and deconstruction) to traditional demolition relevant to specific project objectives and conditions is presented in Tables 2-1 and 2-2 in UFC 1-900-01. Table 13-1 lists typical components/materials that have a high recovery potential.

Construction and demolition (C&D) waste materials such as cardboard, clean wood, bricks, and concrete can easily be recycled or reused.

Table 13-1
Building Components/Materials that have High Recovery Potential

Appliances	Dimensional Lumber	Light Fixtures	Plywood	Tile
Bathroom Fixtures	Doors	Marble	Shelving	Trim
Bricks	Ductwork	Metal Framing	Siding	Windows
Cabinets	Flooring	Paneling	Soil	Wood Beams
Carpeting	Insulation	Pipes	Stairs	

When selecting a contractor or a vendor/manufacturer for work at Fort Hood, the following consideration will help ensure successful implementation of the plan.

1. Work with contractors experienced in salvaging and recycling building materials. This could be a separate contractor to remove salvageable items or require the demolition contractor to remove items for salvage, as well as recycling and recovery. In either case, it is important to provide extra time in the schedule for careful removal of items.

2. Seek out or specify that manufacturers use reusable, recyclable, returnable, or recycled content packaging.

3. Require contractors to train site workers on the proper recycling protocol.

13.6.3 Use of Fort Hood Municipal Landfill

The Fort Hood Municipal Landfill can be used for all construction, abatement and demolition debris generated within the boundaries of Fort Hood, so long as the waste is not classified as hazardous waste. The use of the Fort Hood Municipal Landfill is subject to the operating requirements imposed by the Landfill Operating Permit (Section 01368).

All waste delivered to the landfill will be inspected by the landfill operating contractor for materials that are not authorized in the landfill. Trucks containing unauthorized waste will be diverted for the removal of unauthorized materials before being allowed to proceed to the landfill.

Contractor shall obtain permission from Fort Hood's Directorate of Public Works to use the Post's landfill. Submit documentation granting permission and a completed landfill permit to the Contracting Officer prior to start of construction. For additional information related to CONDITIONS FOR USE OF FORT HOOD LANDFILL and the need for a Landfill Permit, contact the DPW.

Contractors will get a landfill manifest from the Classification Unit for each truck load going into the landfill. Passes will need to have the building numbers, type of waste, and – at the time of the trip to the landfill – the bumper number of the truck and the signature of the driver. The landfill and the Classification Unit need to be notified 24 hours in advance.

Landfill operating hours are 0730-1700 Mon-Fri and 0730-1400 on Saturday. Questions concerning landfill policy and procedures may be answered by calling the landfill at (254) 532-2256.

All requests for Non-Hazardous Manifests will be made to the DPW Classification Unit, Building 1348. Requests shall be made 3 days prior to going to the landfill by calling (254) 288-7627. When calling, provide the following information:

1. Contractors name.
2. Waste stream (use these descriptions only) for which manifests are made include:
    a. Non-friable asbestos (W45NQ9-020).
    b. Friable asbestos (W45NQ9-020).
    c. Building demolition debris (W45NQ9-9992).
    d. Mold contaminated debris (W45NQ9-207).
3. Other manifest requirements are met by contacting the undersigned.
4. Building numbers.
5. Number of manifests needed.
6. Transporters name.

Manifests can be picked up on the day of your landfill appointment, at the Classification Unit, by the transporter. All loads are subject to visual inspection for:

1. Proper bagging of asbestos waste.
2. Appropriate signage on asbestos transport vehicle.
3. Covered waste on open trucks containing demolition debris.

Small loads can be inspected at the Classification Unit when you pick up your manifest before going to the landfill. Large quantities (more than 1 load) are subject to a random inspection scheduled when you request your manifest.

Point of contact for this action is the DPW Classification Unit, Environmental Division, (254) 288-7627.

The following classes of materials are not authorized in the Fort Hood Municipal Solid Waste Landfill and shall be diverted as described below:

Recycle Materials: Cardboard and paperboard, light metal, aluminum and steel containers, paper, and plastic containers. Recyclable materials are to be delivered to the Post Recycling Center Bldg 4621, located at 65th Street and Railhead Drive, (254) 287-6372, Mon-Fri, 0730-1600 HRS.

Compost Materials: Untreated wood, branches, shrubs, grass, wood chips, unserviceable or odd sized pallets should be separated from the refuse load and delivered to the Fort Hood Compost Center located across Turkey Run Road from the landfill. Cedar trees may not be composted and must be delivered to an area designated by the Fort Hood Environmental Office for deposition.

Clean Fill Material and Inert Construction and Demolition Wastes: Soil, sand, sod, rock, clean masonry, brick, concrete, and pavement. These materials are not accepted at the landfill. These materials must be segregated and taken to the material reuse area (IMMU- Inert Material Management Unit) located next to the Fort Hood Landfill as directed by the Contracting Officer or his authorized representative.

Salvageable Items: Tires, white goods and appliances, bulk scrap metal, lead-acid batteries (broken batteries need to be turned in to the Classification Unit) and engine and machine parts. Salvageable items should be delivered to DRMO Bldg. 4286, located at 80th St and Tank Destroyer Blvd, phone 287-2723, Mon-Thurs, 0730-1300.

Serviceable Pallets: Serviceable pallets are to be delivered to the Post Recycling Center Bldg. 4621, located at 65th St and Railhead Dr, phone 287-6732, Mon-Fri., 0730-1600.

Freon: The issue and turn in of Freon will be done at the DPW ENV Classification Unit, Bldg 1348, North Ave. and 37th St., ph: 288-7626, Mon-Fri, 0730-1630. Recovered freon will be collected in 30 or 50 pound recovery cylinders and turned in to the classification unit. An empty recovery cylinder will be issued upon turn-in of the full recovery cylinder if needed. All Freon cylinders, recoverable or disposable will be issued and turned in by serial number. Each person receiving refrigerant must be certified and present their certification card before any issue or turn in is made. Each cylinder will be labeled (R-22, R-134A, etc.) and will not be mixed. If Freon is unintentionally mixed, the contractor will properly tag the cylinder as mixed and inform the DPW classification unit of the suspected mixture upon turn.

Regulated Waste: Regulated wastes such as liquid waste, florescent light bulbs, oil filters, ordinance, explosives, pressurized gases, PCB ballasts, paints, solvents, antifreeze, pesticides, herbicides, radioactive material, and bio-hazardous material are not accepted at the landfill. Regulated waste shall be delivered to the DPW Waste Classification Unit, Bldg 1348, North Ave and 37th St., ph: 288-SNAP, Mon-Fri, 0800-1600, unless otherwise specified in the contract. Ordinance, explosives, radioactive material, and bio-hazardous material are not accepted at the DPW Classification Unit. All turn-ins are by appointment only. Call the DPW Classification Unit, 288-7627, to schedule an appointment. The DPW Classification Unit at times can help contractors with containers, packing procedures, and waste classifications.

Asbestos: Generator of large amounts of asbestos must get manifests from the DPW Waste Classification Unit, Bldg. 1348, located on North Ave and 37th St., ph: 288-7627, Mon-Fri, 0800-1600. Request for manifest will be at least 24 hr in advance. The transporter must have two originally signed manifests and then give the landfill 24 hours prior notice, ph: 532-2256. Delivery of asbestos containing material (ACM), friable and non-friable, must be made prior to 12:00 pm on the day of delivery. All ACM must be double bagged, off-loaded by hand. One large bundle is not acceptable due to the possibility of bag breakage upon off-loading at the disposal activities. Non-friable ACM that has been damaged or has the potential of being damaged by off-loading, grinding, cutting, sanding, disposal or other invasive actions must also be double bagged.

Special Wastes: Properly characterized special wastes including fuel contaminated soils, and demolition debris contaminated with lead paint (TCLP <5.0 mg/L) are allowed in the landfill. Documentation of all characterization tests must be provided to the Fort Hood DPW ENV Hazardous Waste Program Manager and the landfill manager a minimum of 48 hours prior to delivery of the material to the landfill. The Transporter must have a properly completed manifest at the time of delivery to the landfill. Copies of the Landfill's Waste Acceptance Plan, which contains specific requirements for disposal of these materials, may be obtained from DPW Environmental ph: 288-5132, DPW Services ph: 287-9606 or 288-7842, or the Landfill Operating Contractor ph: 532-2256.

The Requirements of this clause are not intended to limit the Contractor's rights. The Contractor may dispose of recyclable, salvageable, regulated materials in any lawful manner he chooses outside of Fort Hood boundaries, to the extent allowed by other contract provisions, with the coordination and authorization of the DPW Classification Unit, Bldg 1348, North Ave. and 37th, ph: 288-SNAP, Mon-Fri 0800-1600.

13.6.4 Hazardous Materials and Waste

Fort Hood has restrictions on chemicals used on the installation. All hazardous materials proposed for use must be pre-approved by DPW-Environmental office. A Hazardous Material Authorization Request (HMAR) form and MSDS conforming to Federal Standard 313d must be submitted. A list of chemicals, their intended use, MSDS, applicable specifications, trade names, and manufacturers shall be submitted to the Contracting Officer and DPW-Environmental, Building 4219, for approval no later than ten (10) normal working days prior to Contract start date, with certifications that the chemicals meet or exceed the Contract requirements.

Chemicals shall be stored and delivered to the job site in the original labeled containers. Labels shall include the chemical name, instructions for use, and warnings. Minimum standards for typical cleaning chemicals are listed below. The Contractor shall submit the same information to, and receive approval from the Contracting Officer, prior to substitution of chemicals used for work on the Contract.

Contractor shall submit Hazardous Materials Inventory for all products stored on Fort Hood Property at least quarterly. Inventory must contain the product name, stock number, manufacturer, and location of storage (by building number and address). All inventories shall be submitted to the Contracting Officer and to DPW-ENV Hazardous Substance Management System (HSMS) Team for any products stored on Fort Hood.

General Haz-Mat Disposal procedures:

Standard procedures are as follows: Environmental Division will sign manifests for all material disposed off post. Where material is taken to Bldg. 1348 for disposal, in most cases containers will be available to give to the contractor for packing and return when filled. Any container weighing more than 750 lb. will not be accepted. Materials of different types cannot be mixed in the same container. If there are any questions on this, call 288-SNAP. While in use for collection at demo sites, waste containers must be properly marked, and closed and secured at all times sites are not manned. It is suggested that no storage for over a week be allowed. There will be no charges to contractors or project funds for items disposed in the landfill, special waste trench or turned in at Bldg. 1348. DPW will continue to pay asbestos removal charges to state. A survey will always be required for rehab or any projects involving building demo. Usually a building survey is done (upon start of a project) by the Fort Worth District team, DPW in-house forces, or an AE team. The survey and its results should be discussed with Environmental Management Office project manager during the concept design

conference and all succeeding conferences, to ensure a clear scope of work and a clear understanding as to how all wastes are removed and disposed of. All clean construction and demolition debris shall go to the IMMU, unless an alternate site is authorized through DPW-Environmental Division. On any project with large amounts of excess fill, contact DPW for an alternate site.

The following specific items are addressed:

1. **Asbestos Containing Material (ACM):**

    a. All ACM will go off site at the Contractor's responsibility; DPW Environmental will sign manifests as has been standard procedure. In total demolition of buildings, mastic and floor tile (non-friable) may usually be disposed of in the DPW landfill.

    b. All notifications of asbestos removal to the state shall be signed by Chief, Environmental Management Office.

2. **Lead- based paint waste:**

    a. Hazardous waste will go off post at the Contractor's responsibility.

    b. Class 1 will be disposed of in the special waste trench at the DPW landfill.

    c. Class 2 will be disposed of in the DPW landfill.

3. **Liquid filled transformers** will be checked for PCBs during the survey normally done before a project. DPW has a database which will pinpoint problem transformers or (when nameplate data is provided) provide information on manufacture. These will normally be turned to DPW Supply, Bldg. 4209, at 77th and Warehouse Streets, with a copy of the analysis. PCB containing light ballasts will also be taken here- if ballasts are unmarked they will have to be considered PCB and brought to this site.

4. **Mercury containing bulbs** (including most fluorescent) will be packed and turned in at Bldg. 1348, DPW Classification Unit. (For all items to be turned in here, Mr. Gary Tooke, phone 254-553-0896, shall be contacted well in advance for requirements and arrangement for drop-off). Every effort must be made to keep from breaking - packing boxes are available which will help. The same will apply to thermostats containing mercury.

5. **Regulated refrigerants** in old refrigerators, compressors, etc. will be purged in accordance with state regulations and the refrigerant turned in to DPW Supply. Pre-arrangement for delivery of the refrigerant is required. Contact Mr. Gary Tooke of DPW Environmental, phone no. 254-553-0896.

6. If the presence of any **unusual items** such as tritium powered exit lights, cesium element smoke detectors, etc. is confirmed, contact Mr. Alex Kachura, 254-288-5132, for instructions.

Where alterations or rehabilitation work require work done in or to existing buildings, the contractor shall ensure that a proper survey of all potentially hazardous materials is done and proper specifications for removal and disposal are included in the project. Fort Hood DPW prefers that materials generated by demolition be disposed of in their landfill. Disposal of potentially hazardous debris is coordinated through DPW-Environmental. Non-inert demolition debris can be taken to the Fort Hood landfill. Provide lists of hazardous material to be disposed of on drawings or in specifications. The contractor shall:

1. Establish procedures and timeframes prior to demolition to inspect and inventory hazardous waste (such as asbestos, fluorescent bulbs, ballasts, cleaning products, appliances, etc.) that may require removal prior to demolition. Establish methods and procedures that will be used to remove materials prior to or during building demolition.

2. Identify parties responsible for the removal, proper handling, and disposal of hazardous materials and materials that require special handling. Also, document the name of the contractor who removed material, their method, and the name of the disposal facility. Include documentation verifying proper disposal, recycling, or destruction of material.

13.7 FHDPW JOB ORDER CONTRACTS

Job Order Contract (JOC) projects that meet the requirements of small or large construction activity will comply with the following:

1. For Small Construction Activity. Complete a Construction Site Notice at least two days prior to commencement of construction activities (TPDES General Permit TXR150000, Part II.D.2).

2. For Large Construction Activity. Complete an NOI at least two days prior to commencement of construction activities (TPDES General Permit TXR150000, Part II.D.3).

3. Develop a SWPPP for small or large construction activities according to the requirements of the general permit.

4. Provide a copy of the Construction Site Notice or NOI to FHDPW-ENV at least two days prior to commencing construction activities, but preferably as soon as possible.

5. Provide a copy of the SWPPP for review as soon as possible, preferably two weeks in advance, but at least two days prior to commencing construction activities.

6. Conduct inspections, maintain controls, and fulfill all other requirements of TXR150000.

The Environmental office will review the SWPPP and return comments. All comments from the Environmental office should be addressed prior to the commencement of construction activities, in order to avoid the need to make major changes to controls after installation.

13.8 CONSTRUCTION SITE INSPECTIONS

FHDPW-ENV may conduct initial, regular, and final inspections of each site authorized by the TPDES Construction General Permit to verify compliance with the permit requirements. Enforcement procedures will be implemented according to the DPW Memorandum of Instruction (MOI) for Construction Site Storm Water Inspection Program. A copy of the MOI can be found at the DPW stormwater website.

13.8.1 Deficiencies

If any deficiencies are noted through these inspections, the operator(s) will be requested to make any repairs or changes as soon as practicable before the next storm event. FHDPW-ENV may opt to conduct a follow-up inspection depending on the number and severity of deficiencies noted during the inspection. Operator(s) also will be required to submit a Reply by Endorsement letter to FHDPW-ENV Environmental Division, through their COR, describing the action taken to correct the deficiencies. The Reply by Endorsement letter must be received by FHDPW-ENV Environmental Division within seven days of receipt of the inspection report.

The SWPPP must be modified based on the results of inspections, as necessary, to better control pollutants in runoff (TPDES General Permit TXR150000, Part III.E.2.). Revisions to the SWPPP must be completed within seven calendar days following the inspection. If existing BMPs are modified or if additional BMPs are necessary, an implementation schedule must be described in the SWPPP and wherever possible those changes implemented before the next storm event. If implementation before the next anticipated storm event is impracticable, these changes must be implemented as soon as practicable. (TPDES General Permit TXR150000, Part III.F.8.(c)).

13.8.2 Final Inspection

FHDPW-ENV may conduct a final inspection when final stabilization has been achieved on the permitted site and all temporary sediment and erosion controls either (1) have been removed or scheduled for removal as defined in the SWPPP, or (2) have been transferred to a new operator if the new operator has sought permit coverage.

A copy of the Notice of Termination (NOT) will be provided to FHDPW-ENV within 30 days after the final inspection (TPDES General Permit TXR150000, Part II.E.1).

13.8.3 Inspection Report

Construction site operators are required by the permit to conduct inspections, therefore, a report summarizing the scope of the inspection, names and qualifications of personnel making the inspection, the dates of the inspection, and major observations relating to the implementation of the SWPPP must be made and retained as part of the SWPPP (TPDES Construction General Permit TXR150000, Part III.F.8.(d)).

Major observations should include the following:

1. Locations of discharges of sediment or other pollutants from the site.
2. Locations of BMPs or controls that need to be maintained.
3. Locations of BMPs that failed to operate as designed or proved inadequate for a particular location.
4. Locations where additional BMPs are needed.

Actions taken as a result of inspections must be described within and retained as part of the SWPPP. Reports must identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report must contain a certification that the site is in compliance with the SWPPP and the TPDES Construction General Permit.

13.9 SPECIAL CONSTRUCTION STANDARDS FOR FACILITY TYPE

For special construction standards related to the following, contact the DPW.

- Vehicle Maintenance Shops.
- Specific Requirements for Mechanical Rooms.
- Specific Requirements for Crane Electric Overhead Traveling.
- Specific Requirements for Ventilation and Exhaust Systems.

13.10 SITE RESTORATION AND STABILIZATION REQUIREMENTS

When restoring disturbed areas to a natural condition, or when stabilizing a construction site that does not have an established planting plan, refer to Section 10 and Appendix I (plant list) for approved plants, planting, and maintenance techniques and requirements.

Final stabilization measures are required prior to the removal of erosion and sediment controls and submission of a Notice of Termination to the TCEQ. Final stabilization measures have been achieved when all soil-disturbing activities at the site have been completed and a uniform perennial vegetative cover with a density of 70% of the native background vegetative cover for the area has been established on all unpaved areas.

13.11 RESOURCES AND REFERENCES

Numerous directives and guidance documents have been published that support Army installations in demolition-debris diversion. Some of these documents, in addition to other resources for information related to construction management, include:

- Air Force Center for Environmental Excellence (AFCEE), *Construction and Demolition Waste Management Guide*, http://www.afcee.brooks.af.mil/eq/programs/summary.asp?rscID=870.
- American Society of Heating, Refrigeration, and Air Conditioning Engineers,1999, *Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size*, ANSI/ASHRAE 52.2-1999.

- Barrett, M.E., June 1999, *Complying with the Edwards Aquifer Rules, Technical Guidance on Best Management Practices*, http://www.tceq.state.tx.us/comm_exec/forms_pubs/pubs/rg/rg-348/, Texas Natural Resource Conservation Commission, Austin, Texas.

- Center for Watershed Protection, Inc., 2001, *Approaches to Stormwater Treatment* CDROM, Ellicott City, Maryland.

- ENV Standard Operating Procedure: *Use of Fort Hood's Inert Material Management Unit (IMMU) (also known as "the rubble pile")* For information contact 254 -287-9184.

- Fort Hood's Installation Pest Management Plan. Contact the Installation Pest Management Coordinator, phone number 254-288-5030.

- King, N., K. Darnaby, A. Foster, H.C. Landphair, J. A. McFalls, D. Thompson, D.F. Noble, D. Stolpa, D. Zwerneman, Revised July 2002, *Storm Water Management Guidelines for Construction Activities*, http://www.dot.state.tx.us/ENV/nrmstormwatermanual.htm, Texas Department of Transportation, Austin, Texas.

- Pintor, S., Fort Hood Construction Criteria, Fort Hood Directorate of Public Works, Environmental Division Municipal Storm Water Program, Fort Hood, Texas.

- PWTB 200-1-23, *Guidance for the Reduction of Demolition Waste Through Reuse and Recycling*, 10 March 2003, http://www.hnd.usace.army.mil/techinfo/CPW/PWTB/PWTB%20200-01-23.pdf.

- PWTB 200-1-31, *Guidance for Addressing Chlordane Contamination at DoD Sites*, 30 September 2004, http://www.hnd.usace.army.mil/techinfo/CPW/PWTB/PWTB%20200-1-31.pdf.

- PWTB 420-49-30, *Alternatives to Demolition for Facility Reduction*, 10 February 2000, http://www.hnd.usace.army.mil/techinfo/CPW/PWTB/4204930.pdf.

- PWTB 420-49-32, *Selection of Methods for the Reduction, Reuse, and Recycling of Demolition Waste*, December 2002, http://www.hnd.usace.army.mil/techinfo/UFC/121602_UFC%201-900-01.pdf.

- Sheet Metal and Air Conditioning National Contractors Association (SMACNA), 1995, *IAQ Guidelines for Occupied Buildings under Construction*, SMACNA, Chantilly, Virginia.

- Texas Administrative Code (TAC), Rule §101.211, Scheduled Maintenance, Startup, and Shutdown Reporting and Recordkeeping Requirements, http://info.sos.state.tx.us/pls/pub/readtac$ext.TacPage?sl=R&app=9&p_dir=&p_rloc=&p_tloc=&p_ploc=&pg=1&p_tac=&ti=30&pt=1&ch=101&rl=211.

- _____, Rule §101.201, Emissions Event Reporting and Recordkeeping Requirements http://info.sos.state.tx.us/pls/pub/readtac$ext.TacPage?sl=R&app=9&p_dir=&p_rloc=&p_tloc=&p_ploc=&pg=1&p_tac=&ti=30&pt=1&ch=101&rl=201.

- Texas Commission on Environmental Quality (TCEQ), Chapter 115 Control of Air Pollution from Volatile Organic Compounds, http://www.tceq.state.tx.us/permitting/air/rules/state/115/r5hp.html .

- _____, March 5, 2003, TPDES Construction General Permit, Permit No. TXR150000, issued by the Environmental Protection Agency Region 6, Dallas, Texas, http://www.tceq.state.tx.us/assets/public/permitting/waterquality/attachments/stormwater/txr150000.pdf and Storm Water Permits for Construction, http://www.tceq.state.tx.us/nav/permits/wq_construction.html

- U.S. Army Corps of Engineers CERL Technical Report 99/58, Concepts for Reuse and Recycling of Construction and Demolition Waste, June 1999, also available via Internet from the CERL web site (PDF file only). Address as of 8/11/2000: current access is available via PURL.

- UFC 1-900-01, *Selection of Methods for the Reduction, Reuse, and Recycling of Demolition Waste*, http://www.hnd.usace.army.mil/techinfo/UFC/121602_UFC%201-900-01.pdf.

- UFGS 01355A, *Environmental Protection*, http://www.wbdg.org/ccb/browse_org.php?o=70.

- UFGS 01572, *Construction and Demolition Waste Management,* http://www.wbdg.org/ccb/browse_org.php?o=70.

- UFGS 02220, *Demolition,* http://www.wbdg.org/ccb/browse_org.php?o=70.

- UFGS 02360, *Soil Treatment for Subterranean Termite Control,* http://www.ccb.org/docs/UFGS/UF02360.pdf.

- U.S. Department of Defense, (DoD), October 2003, *Deconstruction Guide for Military Installations*, http://kppc.org/resources/DoD%20Deconstruction/Presentations/DECON_guide%20(final%2011-03-03).pdf, developed by University of Louisville's Kentucky Pollution Prevention Center and University of Tennessee's Center for Industrial Services..

- U.S. Environmental Protection Agency, 18 June 1997, *Testing for Indoor Air Quality, Baseline IAQ and Materials, Section 01445*, http://www.epa.gov/rtp/new-bldg/environmental/s_01445.htm, Research and Administration Facility, U.S. EPA, Research Triangle Park, North Carolina.

- United States Army Corps of Engineers (USACE), Fort Hood Specification 01368, *Special Project Procedures for Fort Hood*, Part 1.3 Conditions for Use of Fort Hood Landfill, USACE, Fort Worth District, Fort Worth, Texas.

The maximum benefit from the sustainable features designed into a building and site elements (e.g., integrated systems) can be achieved from the proper operation, as well as by educating the facility occupants about how to correctly manage and control the building's and site's sustainable features. Together, these efforts result in significant environmental benefits and reduced maintenance cost because the facility and site is operated efficiently and correctly.

Three factors related to the site and its facilities must work together to achieve the sustainable benefits designed into it: (1) the technical aspects, (2) the manager/maintenance aspects, and (3) the occupant aspect. The technical aspects include those systems designed for and constructed as part of the site, such as the lighting, controls, and equipment (e.g., heating, ventilation, and air conditioning [HVAC] equipment, appliances, plumbing fixtures) and the physical construction of the building (e.g., walls, roof, windows); these are often viewed as the most essential elements in achieving sustainability goals. The facility managers/maintenance and occupants, however, also play significant roles, for if the sustainable features of equipment are not used correctly then the maximum sustainable effect is not achieved, although the cost to provide the design and equipment has already been expended. An education program for facility operators and employees is worth the investment if measured in terms of achieving the optimal sustainable performance from the site and its facilities.

The following discussion focuses on the facility itself; however, the training and education principles introduced apply to the entire site as designed. For instance, LID features designed for the site must be maintained in order to function in their intended manner. Similarly, proper care and maintenance of landscape features is necessary to achieve daylighting design features.

This section sets forth the basic Fort Hood requirements for facility managers/maintenance and building occupant training. The benefits of this type of training meet Fort Hood's 25-Year Sustainable Goal to minimize waste and environmental impact.

Also discussed in this section are requirements related to project deliverables, including the required number copies (e.g., copies of the project design) and electronic format.

14.1 TRAINING REQUIREMENTS

At a minimum, the training requirement for government personnel and building occupancy includes the following from the building contractor:

1. Prior to beneficial occupancy, the contractor shall conduct a training session (one-hour minimum per section of the specification) to brief a minimum of six government personnel and a minimum of six building occupants/users on the operation and maintenance procedures of such systems; and

2. Each piece of equipment and each system shall be demonstrated to operate in accordance with the amperage, temperature differentials, air flow quantity, static pressures, head, and flow, where applicable, for each piece of equipment as a part of the training session.

Final project payment to the architectural-engineering designer/contractor (AE) shall not be made until the above minimum (or as otherwise modified) training requirements have been satisfied.

Sections 14.1.1 and 14.1.2 expanded upon the minumn requirements discussed above to include a focus on the sustainable features of the building to be occupied. These additional requirements should be integrated into the project requirements when the facility is designed with sustainable features.

14.1.1 Facility Managers and Maintenance

Facility managers will operate a sustainable designed facility just as they would any other facility unless they are educated about the differences and what needs to be done differently. They must be informed that the facility is specially constructed to contain sustainability features, what these features are, and what they mean to the facility's sustainable operations. If educated properly, facility managers will take pride in these unique aspects of their facility.

A formalized training session addressing the following elements should be held and attended by all building operators. Fort Hood should consider holding part of this building operator training during the commissioning process to allow the facility managers/maintenance to see the building's mechanical features. The training should include:

1. A definition of a sustainable facility and what it means to Fort Hood, to the community, and to the environment.

2. A listing of the facility-specific sustainability features and a short explanation of each. This should include a walk-through tour with the operators being directly shown these features, to the extent possible.

3. A description of the efforts the facility managers and maintenance must make to obtain the maximum sustainable value from these features. This may include some hands-on demonstrations.

4. A document listing the features along with printed, user-friendly instructions explicitly stating the operations and maintenance (O&M) requirements of these sustainability features. This is in addition to the user/operator manuals that typically accompany equipment.

Photo: Warren Gretz, ©DOE/NREL

Involving facility O&M personnel in the construction process can help ensure O&M concerns are addressed at the start of a building project. This contributes to an improved working environment, higher productivity, and reduced energy and resource costs.

14.1.2 Building Occupants

In addition to the facility managers, building occupants play a significant role in the overall success in achieving a building's sustainability goals, depending on the amount of user interaction required by various building systems. For example, if the building is constructed with manually controlled equipment such as light switches, opening windows, and operable shades, the occupants must consistently and appropriately operate these features. Alternatively, if the facility's features are

automatically controlled, the occupants are required to do very little; however, they also have a minimal sense of personal control.

Central and South West Services, ©DOE/NREL

High-quality training programs are key to changing the behavior of building occupants and users. If the training is successful, participants will take the information and put it into action—incorporating sustainable design concepts into everyday choices.

Achieving optimal sustainable performance from facilities can best be derived from holding a short training session detailing the facility's sustainability features, what the occupants need to control, and why it matters. A simple building orientation seminar should include:

1. A definition of a sustainable facility and what it means to Fort Hood, to the community, and to the environment.

2. A listing of the facility-specific sustainable features and a short explanation of each. This will include all operator-controlled features as well as some of the basic design features that operators will experience but will not control.

3. A description of what efforts facility occupants must undertake to obtain the maximum sustainable value from these features. This may include some hands-on demonstrations.

In addition to seminars, mechanisms to remind persons of the building's sustainable nature and the necessary practices to be conducted therein are needed. Consider installing appropriate labeling around the building and an informational poster at the building entrance to remind building occupants, operators, and visitors of these sustainability features and what they mean to the Fort Hood community.

Training on sustainable aspects of daily operation should be addressed during the new-building occupant orientation. Annual refresher training for building occupants is essential.

14.2 INFORMATION FOR FACILITIES MANAGERS

14.2.1 Background

O&M is one of the most cost-effective methods for ensuring reliability, safety, and energy efficiency of building systems. Operational efficiency represents the life-cycle cost-effective mix of preventive, predictive, and reliability-centered maintenance technologies. Heating, ventilation, and air conditioning and refrigeration (HVAC&R) maintenance and utility costs represent a significant portion of a facility's operating cost. O&M programs targeting energy efficiency can save 5% to 20% on energy bills without

a significant capital investment. Proper O&M is essential to providing good indoor air quality (IAQ) and ensuring that HVAC&R systems operate as designed.

Transferring facility O&M information to facility managers encourages the development of a process to enhance efficient facility O&M.

The building commissioning process is an ideal opportunity for O&M staff to learn about the building systems. The commissioning report should become the basis of a facility "user manual" as it explains the design intent and documents the performance of the various systems. The commissioning report should be placed in a binder to which additional facility maintenance instructions should be added. Include in this "facility binder" information regarding the design intent as well as guidance on how the building should be operated as a whole system.

Photo: Kenneth Shipp - DOE, ©DOE/NREL.

Obtaining up-to-date documentation of all building systems, including system drawings, is an essential element of an effective O&M program.

14.2.2 Requirements

O&M documentation should be prepared as outlined in American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Guideline 4-1993, *Preparation of Operating and Maintenance Documentation for Building Systems*. Per this guideline, the O&M manual should contain the following information:

I. Equipment specification data.
   - Operating and nameplate data; and
   - Warranty.

II. Maintenance program information.
   - Manufacturer's installation, operation, and maintenance instructions;
   - Spare parts information;
   - Preventive maintenance actions;
   - Schedule of actions;
   - Action descriptions; and
   - History.

Photo: Warren Gretz. ©DOE/NREL.

A routine maintenance schedule helps to ensure the integrity and longevity of building systems and subsystems.

Also in accordance with ASHRAE Guideline 4-1993 and Fort Hood requirements, the O&M manual/documentation shall include:

- Complete tear-down/overhaul/repair manuals for each scheduled piece of equipment;
- Complete service literature on the equipment for each scheduled piece of equipment;
- Complete installation manuals for each scheduled piece of equipment;
- HVAC controls drawings and equipment cut sheets;
- Electrical one-line diagrams of the building;
- Duct Layout drawings with control sensor locations;
- HVAC air and water balance reports;
- Fire detection and protection drawings. Also the drawings for fire protection systems shall be half-size prints;
- Commissioning instructions for all facility systems;
- Comprehensive facility O&M instruction manual for system operations, performance verification procedures, and equipment inventory, as well as recommended maintenance schedules;
- A monitoring program that tracks and records building system performance to identify and diagnose potential problems and to track the effectiveness of the O&M program; and
- A periodic training program for facilities managers and maintenance staff regarding facility system O&M (see Section 14.1.1).

HVAC system O&M best management practices (BMPs) should include, but not be limited to, the following:

- Verify that damper linkages and modulating motors on HVAC systems are working properly;
- Clean air handling unit (AHU) coils and fan blades; replace dirty air filters (unit energy savings opportunities can be as high as 10 to 15%);
- Remove scale from condenser coils (unit savings opportunity: up to 25%);
- Clean burner assembly and adjust air/fuel ratio (unit savings opportunity: up to 15%);
- Eliminate belt slippage and poor alignment on fan motors (unit savings opportunity: up to 15%);
- Maintain proper refrigerant levels in chillers and direct expansion systems;
- Adjust the chilled water temperature as loads vary;
- Maintain condenser water flow rate by ensuring proper flow through valves and tubing; and
- Ensure that water treatment equipment for hot water and condenser water systems is operating properly (to prevent fouling of tubes).

Fort Hood procedures for O&M guidelines require that prior to Final Inspection, the AE contractor shall provide final approved copies of: three (3) complete equipment listings (to include name plate data) and three (3) copies of all operation and maintenance manuals to the Contracting Officers Representative for all mechanical/electrical systems, electrical controls, fire alarm, etc. It also requires that no O&M training shall be held without approved O&M Manuals.

14.3 AE DESIGN AND PROJECT DELIVERABLES (FORMAT AND CONTENT)

For as-built projects, the AE will provide CADD drawing files and a matching set of originals (hard copy) generated from the CADD files shall be provided to the DPW. DPW will furnish a copy to DES-Fire & Emergency Services Inspection Section. The AE also will provide a marked-up sepia copy to DPW within one week of final inspection. CADD files shall be Microstation; if AE uses another program they will have to convert the files to Microstation before providing to the Area Office for the contractor to update. For multi-building phased projects, as-built shall be provided with each building as it is completed.

Prior to Final Inspection, the AE contractor shall provide final approved copies of: three (3) complete equipment listing (to include name plate data) and three (3) copies of all operation and maintenance manuals (see Section 14.2.2 for manuals) to the Contracting Officers Representative for all mechanical/electrical systems, electrical controls, fire alarm, etc.

The items identified above shall also be scanned and one CD shall be delivered prior to final payment to the AE contractor.

Data Documents and Standards for Projects

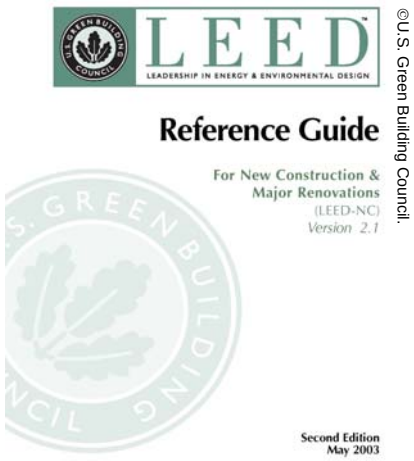
Pursuant to Army Regulation 115-X, 12 July 2004, 1 September 2004, Installation Geospatial Information and Services, Fort Hood requires: (1) All project GIS and CADD data to be documented in accordance with the Federal Geographic Data Committee (FGDC) Content Standards for Digital Geospatial Metadata, and (2) the most current release of the Spatial Data Standard for Facilities, Infrastructure and Environment (SDSFIE) shall be followed for geospatial database table structure, nomenclature, and attributes to allow for data integration. CADD data shall be documented according to the current release of the AEC/CADD standards. Project data submitted to Fort Hood that are not in compliance with these two requirements identified by Fort Hood shall be returned to the architects, contractors, and/or design professionals for correction.

14.4 LEED VERIFICATION AND COMPLIANCE

All new construction and major renovation projects starting with the FY 08 military construction program are required to achieve the SILVER level of LEED NC (Leadership in Energy and Environmental Design - New Construction). In addition, while the USGBC has not yet finalized nor has the US Army adopted LEED-Homes, Fort Hood will use this system for rating all Army Family Housing new construction projects and homes built under the Residential Communities Initiative. A level of SILVER will be strived for. See Section 1 of this IDG for more information on how LEED is being implemented at Fort Hood.

During the design planning charrettes, the design team identifies credits they will try to achieve on a particular project to ensure the LEED certification level is achieved. To ensure that the necessary LEED level is actually achieved, verification and documentation from the party responsible (this could be the contractors or Fort Hood personnel, the responsible party will be determined during the actual charrette) for achieving the credit must be. The verification/documentation shall be submitted to the project file. For any credit not subsequently achieved, justification for not achieving the credit must be provided in the project file. Justification may include information from the construction contractor regarding the lack of availability (e.g., a specific product/system), or higher cost of a particular product or material, or an approved change in the building design. A higher cost justification must demonstrate a payback period beyond what is acceptable to Fort Hood (also see Section 1.9).

The LEED Reference Guides shall be consulted for detailed information regarding how credits should be determined/calculated and documented to verify compliance with the standards. For additional information about LEED verification and compliance contact the Fort Hood LEED Coordinator, DPW – Environmental at (254) 287-6499 or visit the USGBC website at www.usgbc.org.



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The USGBC's LEED Reference Guide provides detailed information on the incorporation of sustainable design strategies in new construction building projects.

14.5 BUILDING COMMISSIONING

Commissioning is a process, not a technology that can be purchased. The goal of building commissioning is to verify and ensure that fundamental building elements and systems are designed, installed, and calibrated to operate as intended. A commissioned building provides optimized energy efficiency, indoor air quality, and occupant comfort and sets the stage for minimal O&M costs. Existing USACE guidance and industry standards are the "tools" by which commissioning can be properly implemented. At a minimum, Fort Hood requires commissioning on all mechanical systems over 10 tons; however, other building systems and assemblies (see discussion below) that affect the operational performance of a building should be considered during the charrette process for the commissioning requirement. As determined through the charrette process, additional commissioning requirements can be integrated into the project requirements.

Some degree of commissioning is worthwhile in nearly every project, although the importance of commissioning increases as facilities get more complex. Large, mixed-use facilities are important commissioning targets, as are those with laboratories, assembly halls, and other large ventilation loads. The commissioning process should establish and document the owner's criteria for system function, performance, and maintainability, as well as verify and document compliance with these criteria throughout design, construction, start-up, and the initial period of operation. In addition, complete O&M manuals and training on system operation should be provided to the building operators to ensure the building continues to operate as intended.

The following forms contained in the USACE Publication TM 5-697 can be used to assist with HVAC system commissioning:

- **DA Form 7477-R Heating Water Inspection Checklist**
- **DA Form 7478-R Chilled Water Inspection Checklist**
- **DA Form 7479-R Ventilation System Inspection Checklist**

The commissioning provider (CP) should be involved throughout the project from the pre-design through the warranty phase. The CP can be an independent third-party agent or a member of the architectural/engineering or construction management firm. The primary role of the CP during the overall design phase is to develop detailed commissioning specifications and review the design to ensure it meets the owner's objectives. During construction, the CP develops and coordinates the execution of a testing plan, which includes observing and documenting all systems' performance to ensure that systems are functioning in accordance with the owner's objectives and the contract documents. The CP is not responsible for design or general construction scheduling, cost estimating, or construction management, but may assist with problem-solving or addressing non-conformance issues or deficiencies.

The commissioning process typically focuses on HVAC systems and their controls; however, other building systems and assemblies that affect operational performance and that should be included in the commissioning process include:

- Building envelope technologies;
- Interior and exterior lighting and controls;
- Daylighting systems;
- Plumbing fixtures and plumbing infrastructure;
- Irrigation and rainwater harvesting systems;
- Water treatment systems; and
- Other advanced performance technologies.

Photo: David Parson, DOE/NREL

The designer should incorporate building commissioning to ensure that a building performs in accordance with the design intent, contract documents, and the owner's operational needs.

Any system that has historically been troublesome to O&M staff in similar facilities should be targeted for specific attention during commissioning.

Specifically, HVAC system commissioning includes:

- Systematically evaluating all pieces of HVAC equipment to ensure they are working according to specifications; and
- Reviewing the sequence of operations to verify that the controls are providing the correct interaction between all pieces of HVAC equipment.

HVAC system commissioning is more than just testing, adjusting, and balancing (TAB), as described in Section 8.14.1.5.

The practices of continuous commissioning or building system checks (see Section 14.6) and annual recommissioning should also be considered. Continuous commissioning involves ongoing monitoring and testing of systems as part of a regular maintenance plan to ensure optimum performance and enhance longevity. Recommissioning is a less regular but more extensive examination of building operations similar to the initial commissioning. Both procedures are attempts to keep buildings operating as they were designed throughout their life cycle.

A properly designed and executed commissioning plan generates substantial operational cost savings. Properly implemented commissioning on new facilities and retro-commissioning on existing facilities can reduce construction change orders and contractor warranty call-backs, reduce O&M tasks, and improve a facility's comfort for enhanced worker productivity. For an average cost of $0.30 per square foot on new facilities, potential energy savings of 20% to 50% can be attained. Retro-commissioning can provide potential energy savings from 5% to 20%.

14.6 POST-OCCUPANCY EVALUATION

To achieve the maximum benefit from the sustainable features designed into a building, facility occupant feedback and routine maintenance checks are necessary. The obvious benefit from routinely obtaining this feedback is that it facilitates building system adjustments which, when made, will help achieve, as closely as possible, the maximum sustainable effects of the facility. The incremental costs of obtaining this feedback and conducting routine equipment checks are offset by reductions in the facility's overall energy, material, and water consumption, as well as by conservation of labor, maintenance, equipment, and materials.

Despite the best intentions of designers, some building features that were installed to increase the sustainable nature of the building operation are not consistently used because they cause worker discomfort. Usually this results from improper settings and/or locations of the features. For example, occupancy sensors that are not properly located may result in a person entering several feet into a dark room prior to the sensor detecting his or her presence. Also, room lights may be set to remain on too long following occupant departure. These types of problems require immediate attention because, if left unchanged, they will cause inappropriate use or application of the feature(s) by building occupants and will likely lead to future negative publicity for the sustainable design features incorporated into the building design.

Requirements

The first step prior to any facility opening for use is a complete commissioning (see Section 14.4) in which every building system is checked to ensure that it functions as intended. Any problems identified must be addressed prior to the facility opening.

While commissioning is essential, it will not guarantee optimal sustainable feature operation due to the variation in human comfort needs. Adjustments will be necessary to reach a balance between

accommodating comfort needs while simultaneously achieving sustainable design goals for the building.

During the first few weeks of building occupancy, occupants will quickly identify those features resulting in visual, thermal, or acoustic discomfort. A meeting attended by ALL building occupants and the facility operations staff must be held within the first two weeks of facility operation. This meeting will provide an opportunity for occupants to report to facility management which features are functioning and which require adjustment. Rapid remediation of these issues by the facility management staff is *essential* to gaining occupant acceptance of sustainable features. It is also necessary for obtaining their cooperation in implementing sustainable actions in their daily activities at the facility, e.g., placing waste in the appropriate solid waste management container and turning off equipment when not in use. By demonstrating wholehearted commitment to the proper operation of the facility's sustainable features, facility managers will generate cooperation from occupants. Ambivalence by facility managers, on the other hand, may result in a lack of practicing sustainability in daily activities and likely will prevent the facility itself from achieving optimal sustainability from the installed features.

Photo: Warren Gretz, ©DOE/NREL.

Routine checking of building system performance such as lighting and daylighting helps to identify and diagnose potential problems and track the effectiveness of the O&M program.

In addition to the initial post-occupancy review, facility managers should routinely (at least once per quarter) conduct building system checks and associated maintenance to achieve the maximum sustainability value of facility features and to prolong equipment life. Building system functional testing should include (if present):

- Functionality of automatic lighting controls;
- Occupancy sensor sensitivity and timing; and
- Automatic faucet and toilet functionality.

In addition to system function checks, the quarterly system maintenance should include:

- HVAC system motor lubrication and belt pulley tension adjustments;
- HVAC system filter replacement, depending on filter lifespan;
- Building control system set-point review and adjustment, per heating/cooling zone;

- Automatic faucet and toilet sensitivity and shutoff delay time; and
- Automatic hand dryer shutoff time.

Quarterly testing and maintenance is not nearly as exhaustive as recommissioning; it is intended to optimize equipment operation. It is not a substitute for annual recommissioning, which is a thorough check of all building systems to ensure that all are operating as intended. The facility manager will receive a tour of all adjustments made by the building commissioners at the conclusion of each annual recommissioning event.

Photo: Warren Gretz, ©DOE/NREL.

Determining electrical energy consumption is relatively straightforward, and an ordinary electrical meter is adequate for simple daily, weekly, or longer electrical energy determinations.

14.7 LONG-TERM MEASUREMENT AND VERIFICATION

Fort Hood is committed to reducing energy costs and protecting the environment through the implementation of sustainable design and development principles. It is important to measure the results of these efforts as a means of justifying budgets for capital improvements and for determining the long-term benefits received from these investments. These measurements can provide feedback on whether investments are producing the anticipated benefits. If they are not, monitoring may identify reasons for the short-falls and help facility managers improve building system performance. As such, Fort Hood requires utilities (gas, water, electric) to be metered to the building with an electrical monitoring connection to a meter interface unit.

The International Performance Measurement and Verification Protocol (IPMVP) provides a wide range of measurement and verification alternatives, including stipulations based on engineering calculations, metering, and using the results of a short-term test to calibrate computer models. More detailed and labor-intensive efforts yield more information, but the value of the information must be weighed against the cost of the measurement and verification program. The IPMVP also presents best practice techniques available for verifying savings produced by energy efficiency and water conservation projects.

The actual instrumentation installed and used and the commitment to continuous measurement are essential for ongoing accountability and optimization of building performance. They provide a means for measuring baseline energy and water use, for commissioning new systems, and for optimizing long-term performance; they also serve as the basis of performance metrics.

Simple, low-cost measurements features, such as metering equipment, are often adequate and cost-effective. Tracking features provide an effective way to collect consumption and demand information from building systems consuming energy (e.g., British thermal units [Btu; HVAC equipment] and electricity) or water. However, the appropriate measurement and verification strategy and the associated cost for a particular project must be determined by assessing the complexity of the project. Factors affecting the costs of measurement and verification include:

- The number of energy/water measures implemented;
- The size and complexity of energy/water conservation measures; and
- The interactions between energy/water conservation measures.

To continue Fort Hood's commitment to reducing energy costs and protecting the environment, Fort Hood should establish procedures and a plan for performance measurement and verification of the systems and equipment installed in a building. IPMVP standards should be used and should include:

- A listing of systems and equipment to be monitored;
- A definition of building baseline energy and water conservation performance; and
- A methodology to verify projected savings.

14.8 REFERENCES

- ASHRAE Guideline 1-1996, *The HVAC Commissioning Process, http://www.ashrae.org/template/AssetDetail/assetid/32943#Gdl1.*
- ASHRAE Guideline 4-1993, *Preparation of Operating and Maintenance Documentation for Building Systems,* http://www.ashrae.org/template/AssetDetail/assetid/32943#GPC4-1993R.
- International Performance Measurement and Verification Protocol (IPMVP), 2002, *Concepts and Options for Determining Energy and Water Savings*, http://www.ipmvp.org/.
- USACE, 2002 Publication Number: TM 5-697 Commissioning of Mechanical Systems for Command, Control, Communications, Computer, Intelligence, Surveillance, and Reconnaissance (C4ISR) Facilities, http://www.usace.army.mil/inet/usace-docs/armytm/tm5-697/toc.htm.

1. **Construction General Permit:** Determine if coverage under TPDES General Permit No. TXR150000 (Construction General Permit) is required for this project, and prepare and submit appropriate documents. Contact 254-287-8712. Construction General Permit Regulatory Requirements.

2. **Hot Work Permit:** A Hot Work permit is required for any operation involving open flames and producing heat and/or sparks. Examples include, welding, burning, brazing, touch cutting soldering, grinding, etc. For additional information related to Hot Work permits contact 254-288-5820.

3. **Digging Permit:** Contractors must obtain an approved digging permit (Form 200-X10) for all excavating or ground penetrations. All general contractors and all subcontractors must have a digging permit for each site. Allow at least three weeks for scheduling. The contractor shall allow for 21 days for government review of digging permit request. The contractor shall apply immediately after contract award for the digging permit. Digging and/or excavation shall not start until approval of digging permits. A digging permit for a specified area of excavation expires 30 days after the issue date; the Contractor must re-apply for a new permit to perform excavation in the area if the excavation was not started within the 30-day period. Permits will identify all underground utilities within 1,500 mm 5 feet of the designated area. Contractor shall be responsible for all repairs, costs, and damages due to excavating without permit or damaging an identified utility. Unidentified utilities shall be repaired by the Contractor at Government expense.

4. **EMS Requirements:** All personnel must be familiar with the EMS policy, and are required to take the 12-minute EMS Awareness Training "Maintaining the Balance" prior to performing any work on the installation. To take the course, log-in at https://lmp.hood.army.mil/lmp/login.aspx, or obtain a copy of the course by contacting DPW-Environmental at 254-287-8755 or 254-288-5256.

5. **Stormwater Pollution Prevention Plan**: A SWPPP is required prior to beginning construction activity. A construction phasing plan is required for site disturbance greater than 5 acres. The plan should be included as part of the SWPPP. Approval of erosion and sediment controls for construction shall come from the Water Program Manager. Contact 254-287-8712.

6. **Utility Marking:** Contractors/Design Teams needing underground utilities marked during a site visit must schedule a time in advance of visit to ensure availability of DPW, DOIM, Cablevision, and telephone utility locators.

7. **Construction Waste Management Plan**: The plan shall cover: (1) recycling, recovery, and deconstruction of the existing facility; (2) recycling of construction waste, including site excavated soils and vegetation; and (3) disposing of hazardous waste. The plan must be approved by the Solid Waste Program Manager: 254-287-9184 or 254-287-6499.

8. **Indoor Air Quality Management Plan:** This plan shall address the protection of the ventilation systems components during construction and cleanup of contaminated components after construction is complete.

9. **Outdoor Air Quality**: Comply with requirements outlined in 30 Texas Administrative Code Rule 116.110 prior to work beginning for construction of new facilities or in the modification of an existing facility which may emit air contaminants. Contact 254-287-8714.

10. **Pest Prevention and Control:** All new and renovation construction projects at Fort Hood will be reviewed for pest prevention and control measures. Submit development design documents for pest management review. Conduct pest management in accordance with the Installation Pest Management Plan. 254-288-5030.

11. **National Environmental Policy Act (NEPA):** NEPA documentation must be completed prior to the undertaking of any land disturbance activity unless otherwise determined not to be applicable to the action to be taken.

12. **Water Resource Permit:** Prior to the undertaking of activities that affect the nation's waterways, described as "navigable waters of the United States" and "waters of the United States" to include wetlands, a permit must be acquired.

13. **Landscape Plan:** Prepare a landscape plan for approval by the Fort Hood Agronomist. For additional information, contact the Agronomist at 254-288-3211.

14. **Design for Corrosion Prevention:** U.S. Department of Defense Directive 5000.1, Defense Acquisition System, requires corrosion prevention control and mitigation to be considered during life-cycle cost tradeoffs. Also see Corrosion Prevention and Control Planning Guidebook, Spiral Number 2, July 2004.

15. **Street Closings:** Street closing will not be permitted without approval. At least one lane of traffic will be maintained at all times. Traffic control signs and barricades will be provided for all street widening and extensions. The designer shall include in the contract documents a traffic control plan for each section of road that will be worked on or impacted as a result of this contract. The traffic control plan shall be in accordance with "Traffic Controls for Street and Highway Construction and Maintenance Operations" of the latest edition of the "Texas Manual on Uniform Traffic Control Devices." A traffic control plan will be submitted to DPW for approval 21 days prior to the proposed construction start, to allow for proper notification of all parties concerned.

16. **Cultural Resources:** Prior to any land disturbance activity the Cultural Resource Program Manager shall review proposed land disturbance activities for compliance with National Historic Preservation Act. Contact 254-287-1092.

17. **Backflow Prevention**: Backflow prevention assemblies shall be installed in accordance with the requirements of the TAC (Texas Administrative Code) Title 30 Environmental Quality, Part 1 TCEQ, Chapter 290 Public Drinking Water, Sub Chapter D Rules and Regulations for Public Water Systems, Rule 290.44 Water Distribution Rule 290.46, and 290.47. The TCEQ (Texas Commission on Environmental Quality) administers all rules of the TAC. All backflow prevention assemblies that are installed on Fort Hood, Texas, will be tested upon installation by a licensed backflow assembly tester certified by the TCEQ. The original signed and dated test reports will be turned into the DPW, Chief of Services Division Building #4612-A, Engineer Drive, Fort Hood, Texas. The backflow assemblies will be installed not less than 36 inches above the ground, not greater than 42 inches above the ground, and will be located not less than 12 inches from any wall. The assemblies will not be installed where they obstruct access to any mechanical components or near electrical components.

18. **Customer Service Inspections:** Before continuous water can be provided, Texas law requires an inspection of a private water distribution system as a way to insure the water is safe to drink. The customer service inspection is used to identify two potential sources of contamination. One is a cross-connection—an actual or potential connection between a possible source of contamination or pollution and the other source is lead associated with plumbing materials. Customer service inspections will be performed by plumbing inspectors, customer service inspectors licensed by the TCEQ, and water supply protection specialists licensed by the Texas State Board of Plumbing Examiners. The original inspection reports will be turned into the DPW, Chief of Services Division at Building #4612-A, Engineer Drive, Fort Hood, Texas. TAC Title 30, Chapter 290, Subchapter D, Section 290.46 provides guidance to better understand the requirements of customer service inspections. Contact DPW.

19. **Sewage systems:** Sewage systems will be designed for compliance with TAC Chapter 317 Design Criteria for Sewage Systems, which sets minimum standards necessary for domestic wastewater treatment systems to function properly and meet requirements for effluent quality. The criteria also contain certain safety standards.

20. **Drinking Water Systems:** Drinking water systems will be designed for compliance with TAC Chapter 290, Public Drinking Water, which provides for, among other requirements, rules, and regulations for public water systems.

21. **Plumbing Work:** All plumbing work shall be conducted in accordance with the 2003 International Plumbing Code.

22. **Landfill Permission:** Contractor shall obtain permission from Fort Hood's Directorate of Public Works to use the Post's landfill. Submit documentation granting permission and a completed landfill permit to the Contracting Officer prior to start of construction. For additional information related to CONDITIONS FOR USE OF FORT HOOD LANDFILL and the need for a Landfill Permit, contact DPW.

23. **Landfill Manifest**: Contractors will get a landfill manifest from the Classification Unit for each truck load going into the land fill. Passes will need to have the building numbers, type of waste and at the time of the trip to the landfill, the bumper number of the truck and the signature of the driver. The landfill and the Classification Unit need to be notified 24 hours in advance.

24. **Inert Construction/Demolition Material:** Fort Hood's Environmental Standard Operating Procedures that detail the use of the Inert Material Management Unit are provided in *Use of Fort Hood's Inert Material Management Unit (IMMU)* (also known as "the rubble pile"). All inert material (concrete, asphalt, clean fill, rock and masonry) removed as the result of demolition, construction or site improvements shall be transported to the IMMU vicinity of Clarke Road and Turkey Run Road (next to the Fort Hood municipal solid waste landfill). Alternate sites can be identified and approved on a case by case basis with coordination through DPW-Environmental Division. For information about these procedures, contact 254-287-9184.

25. **NRC Radiation Permits:** NRC radiation permits are required for use, storage, and possession of radiation sources on Army installations; such as, nuclear density meters and lead based paint detectors. A permit is not required for intermittent use, where sources are stored off the installation and are used for short periods of time and not on a regular basis. Before radiation sources are brought on the installation contact the Installation Radiation Protection Officer at 254-287-3329.

26. **Substance Restricted Use List:** Fort Hood maintains a substance Restricted Use List. Information pertaining to the materials on this list can be found by contacting 254-287-9718. All units/activities, including contractors that store hazardous material are required to submit Hazardous Materials Inventories at least quarterly to the DPW-ENV Hazardous Substance Management System team for any hazardous products stored on Fort Hood. To contact the team, call 254-287-9718.

27. **Installation Airfield:** Contractors performing work under contract may use airfields at Fort Hood with prior written notification and approval, providing (for more information contact DPW):

a. All requests for Installation Airfield use shall be coordinated through the Directorate of Aviation Operations, IMSW-HOD-PLA, Robert Gray Army Airfield, Fort Hood, TX 76544-5032, telephone (254) 287-8338 / 288-5807.

b. All projects on installation airfields will be subject to airfield SOPs and Airfield Management guidelines.

c. Potential users shall submit completed DD FORM 2400 (Certificate of Insurance), DD FORM 2401 (Civil Aircraft Landing Permit), and DD FORM 2402 (Hold Harmless Agreement). Forms are available through the Point of Contact (POC) mentioned in paragraph (a) above. User requests and specified forms shall be submitted at least 60 days before the first intended landing.

d. The attached Section 01128 (Encl. 1) on airfield use and digging permits is already in use for some current contracts and shall be used on all future contracts.

APPENDIX A

Design Team IDG Checklist

The following 'Design Team IDG Checklist' will be completed by the Design Team for all new construction, major renovation, maintenance, or other projects that impact the appearance of Fort Hood.

The Chief of Master Planning shall provide the checklist to all teams designing new facilities, additions, or renovations to existing facilities, or maintenance on the installation. All components of the Design Team IDG Design Checklist are to be completed by the Design Team to assure the guidelines and standards have been considered and complied with in the design process, and by the Chief of Master Planning in project review. For more information on this checklist, see Section 2 of the IDG.

ARMY INSTALLATION DESIGN GUIDE (IDG) COMPLIANCE CHECKLIST

1. PROJECT TITLE AND DESCRIPTION

Title:_____

Description:_____

_____

2. PROJECT JUSTIFICATION:_____

_____

_____

3. SUSTAINABLE DESIGN:

a. Does the project meet or exceed the U.S. Green Building Councils LEED-NC Silver level for new construction or major renovation projects?

Yes _____ - Review project as submitted.

No _____ - Return submittal to design team for revisions to meet LEED-NC Silver or attach appropriate waivers.

b. Are project Waivers from the IDG necessary?

Yes _____ - If yes, provide waiver explanation for consideration and for the project record.

No _____

4. SITE PLANNING

a. Was a site plan prepared for the proposed project utilizing the Site Analysis Process identified in Section 7.3 of the IDG?

Yes _____ No _____

b. Does site planning comply with the standards identified in this IDG? If not, provide justification.

_____

_____

c. Does the site plan meet antiterrorism/force protection (AT/FP) requirements identified in Section 12 of the IDG?

Yes _____ No _____

d. Does site planning meet approved installation Master Plan siting compliance?

Yes _____ No _____ If not, provide justification.

_____

_____

e. Designer comments on site planning:

_____

_____

f. Has the proper NEPA actions been initiated for the construction effort in accordance with AR 200-2?

Yes _____ No _____

h. Does the project impact airspace use relative to:

- Airfield accident potential zones? Yes _____ No ____
- Noise zones? Yes ___ No ____
- Obstacle height requirements in the airfield surface clear zone? Yes _____ No ____
- Any Federal Aviation Administration (FAA) regulations which may restrict project sitting? Yes _____ No ____

5. BUILDINGS

a. Does the building exterior design meet the building design objectives defined in the IDG?

Yes _____ No _____

b. Is the exterior building designed to meet the structural and sustainable material characteristics defined in the IDG?

Yes _____ No _____

c. If the project is a renovation or addition, does the proposed renovation or addition meet IDG building design and structural and sustainable material characteristics?

Yes _____ No _____

d. If the project is a renovation or addition to a historic building, does the renovation or addition maintain the design integrity of the original building or meet Historical Approval Agencies' requirements for any deviations?

Yes _____ No _____

e. Does the building exterior design meet AT/FP requirements (if applicable)?

Yes _____ No _____

f. Designer comments on exterior building design:

_____

_____

g. Does building design comply with the IDG? If not, provide justification.

_____

_____

6. CIRCULATION

a. If the project includes roadway construction, does the proposed plan meet federal highway and/or local guidelines defined in the IDG?

Yes _____ No _____

b. If the project includes roadway construction, does the proposed plan meet AT/FP roadway setback requirements defined in the IDG?

Yes _____ No _____

c. If the project includes roadway construction, does the proposed plan include applicable roadway alignment and intersection guidelines defined in the IDG?

Yes _____ No _____

d. Have potential impacts to existing roadway and intersection capacity been considered?

Yes _____ No _____

e. If the project is an entrance gate, does the proposed plan include entrance gate guidelines and standards defined in the IDG?

Yes _____ No _____

f. If the project includes parking, does the proposed plan meet the parking lot location/design guidelines defined in the IDG?

Yes _____ No _____

g. If the project includes pedestrian circulation, does the proposed plan meet the walkways and pedestrian circulation guidelines in the IDG?

Yes _____ No _____

h. If the project includes bicycle circulation, does the proposed plan meet the bikeway guidelines in the IDG?

Yes _____ No _____

i. Designer comments on circulation design:

_____

_____

j. Does circulation design comply with the IDG? If not, provide justification.

_____

_____

7. Landscape Design

a. All projects for new construction require a landscaping design plan for the planting of trees shrubs and/or groundcover. Does the landscape design comply with the IDG?

Yes _____ No _____

b. Has the plan for this been reviewed by the Fort Hood agronomist?

Yes _____ No _____

c. Does the proposed plan meet AT/FP requirements defined in the IDG?

Yes _____ No _____

d. Does the proposed landscape design plan include plant material recommended in the selected plant palette matrix (Appendix N) included in the IDG?

Yes _____ No _____

e. Designer comments on landscape design:

_____

_____

_____

8. SITE ELEMENTS

a. Does site elements design comply with IDG?

Yes _____ No _____ If not, provide justification:

_____

_____

b. If the project includes site furnishings, does the proposed plan follow the guidelines in the IDG, including the guidelines for sustainable materials?

Yes _____ No _____

c. If the project includes signs, does the proposed plan meet the signs standards in the IDG.

Yes _____ No _____

d. If the project includes exterior lighting, does the proposed plan meet the exterior lighting guidelines defined in the IDG?

Yes _____ No _____

e. Will all power and other distribution lines be located underground?

Yes _____ No _____

f. Will all substations and transformers be designed so they are screened from view?

Yes _____ No _____

g. Will all sewer and water lines be located underground?

Yes _____ No _____

h. Are all storm drain systems designed to meet the guidelines defined in the IDG?

Yes _____ No _____

i. Are all utilities (gas, water, electric) metered to the building with an electrical monitoring connection to a meter interface?

Yes _____ No _____ If not, provide justification:

_____

_____

j. Has transient voltage surge suppression been furnished for all buildings having voltage-level sensitive electronic equipment such as computers?

Yes _____ No _____ If not, provide justification:

_____

_____

k. Designer comments on site elements design:

_____

_____

9. Anti-Terrorism / Force Protection Design Standards

a. Does Anti-Terrorism/Force Protection (AT/FP) design comply with the IDG?

Yes _____ No _____ If not, provide justification:

_____

_____

b. Have building setbacks from roads, parking, other buildings been included?

Yes _____ No _____

c. Do site plans and landscape plans include the criteria outlined for AT/FP?

Yes _____ No _____

d. Have Fort Hood's Security and Force Protection personnel been consulted?

Yes _____ No _____ If not, provide justification:

_____

_____

e. Designer comments on AT/FP compliance:

_____

_____

10. CORROSION PREVENTION AND CONTROL

a. Has corrosion prevention and control been considered and included as a part of sustainable design in this project?

Yes _____ No _____ If not, provide justification:

_____

_____

b. Has corrosion prevention and control been considered and included in the Life Cycle Cost Analysis (LCCA) for this project?

Yes _____ No _____ If not, provide justification:

_____

_____

I hereby certify that the information provided is in compliance with the guidelines of the installation or applicable IDG, except as justified as non-compliance.

_____ _____

Designer of Record **Date**

Concur _____ **Deny** _____; **Explanation of denial is attached.**

_____ _____

IDG Coordinator **Date**

Accept _____ **Deny** _____; **Explanation of denial is attached.**

_____ _____

Command Review (Where Applicable) **Date**

APPENDIX B

Project Requirements IDG Checklist

The following Project Requirement Checklist should be used as a pre-design planning tool for initiating projects and to present a functional description of the project at Military Construction (MILCON) Planning Charrettes and Design Charrettes. This checklist is completed by the Chief of Master Planning and is provided to the Design Team.

PROJECT REQUIREMENTS CHECKLIST

For completion by installation personnel for use in preparation of Requests for Proposal (RFPs).

PROJECT _____ **LOCATION** _____

DPW/DIS POC _____ **PH#** _____

ADDRESS: _____

_____

E-MAIL _____

DATE CHECKLIST COMPLETED _____ **BY** _____

When completing this form it is important to remember that it is the responsibility of the installation to resolve any conflicts between the different "users" (i.e., DPCA, DPW, etc.) about wants, needs, etc. The A/E that prepares the RFP must have the specific guidance contained herein to get you what you want. If there is information you wish to provide that is not specifically requested or you are unable to make your desires clear within the confines of this checklist, add those comments at the end.

1. GENERAL INFORMATION

A. Maps and plans available: (Provide copies with completed checklist)

1. Basic Information Maps (BIMs): (list drawing numbers)

   (Maps should be provided in Spatial Data Standards [SDS]-compatible GIS format whenever possible.)

   Site Topography: _____

   Site Sanitary Sewer: _____

   Site Storm Sewer: _____

   Site Electrical: _____

   Site Water: _____

   Site Plan Extract - from RPMP (Future Development Site Plan): _____

   Other: _____

   Project Location Plans: _____

   Area Map: _____

   a) Site Map: _____

2. Aerial Photograph (Preferred to Topographic)

3. USGS Map

4. Project Siting Plan (Proposed)

5. Environmental

   a) Jurisdictional wetlands designation
   b) Other historical concerns

B. Project Building Plans: (If renovation/addition or prior design, provide available information and plans)

1. Foundation
2. Basement
3. Floor
4. Structural
5. Roof
6. Elevations
7. Electrical
8. Mechanical
9. Plumbing
10. Site Utilities
11. Specifications
12. Other

C. Applicable Codes and Standards:

List all known applicable codes and regulations. Generally, NAF construction will not follow Federal or Military Specifications.

Department of Defense (DoD) governing criteria is UFC 1-200-01, *Design: General Building Requirements*, 31 July 2002.

Local Building Codes: _____

State and County Codes: _____

Environmental Regulations: _____

Installation Regulations: _____

Cultural Regulations: _____

Other: _____

National Fire Protection Codes (NFPA), Military Handbook 1008C

1.1 TEMPORARY FACILITIES AVAILABLE TO THE CONTRACTOR

A. Facilities available to contractor during construction:

1. General Site Plan has been annotated to show limits of construction site: Yes _____ No _____
   If the contractor requires the use of additional area, written approval must be obtained from the Contracting Officer.

2. Construction office available: Yes _____ No_____

3. Covered materials storage available: Yes _____ No_____

4. Uncovered materials storage available: Yes _____ No_____

   NOTE: Security of construction site and materials is the Contractor's responsibility.

5. Select fill borrow areas, spoil areas, sanitary fill and haul routes are shown on attached installation map: Yes_____ No _____

   List any restrictions or notes on the use of those areas: _____

   NOTE: Disposition of scrap and salvageable materials resulting from construction is the responsibility of the contractor unless otherwise noted and agreed.

B. Utilities available to contractor during construction:

1. Potable Water: Yes_____ No _____

   Metering required: Yes_____ No _____

2. Non-Potable Water (Irrigation, Machine Washing, etc.): Yes_____ No _____

   Metering required: Yes_____ No _____

3. Electricity: Yes_____ No _____

   Metering required: Yes_____ No _____

4. Natural gas: Yes_____ No _____

   Metering required: Yes _____ No _____

5. Sanitary sewer: Yes _____ No _____

6. Refuse disposal: Yes _____ No _____

NOTE: Utilities used at the construction site may be metered and/or charged to the contractor. The rate schedule for utilities will be provided as part of this completed checklist and shall be the basis by which the installation will bill the utility usage. Installation of temporary meters, where required, and temporary tie-ins to the utility systems shall be the responsibility and at the cost of the contractor.

1.2 DIGGING PERMIT REQUIRMENTS

Digging Permits.

Design Teams needing underground utilities marked during a site visit must schedule a time in advance of visit to ensure availability of DPW, DOIM, Cablevision, and telephone utility locators.

Contractors must obtain an approved digging permit (Form 200-X10) for all excavating or ground penetrations. All general contractors and all subcontractors must have a digging permit for each site. Allow at least three weeks for scheduling.

Digging Permit required: Yes_____ No_____

1.3 DEMOLITION REQUIREMENTS

Facilities for demolition, relocation, or retention.

Provide description, size, type construction, and location of any existing facilities on the site that must be demolished, relocated or retained. Consider all structures, foundations, pavements, communications, and utilities (whether active or abandoned). Consider demolition hazards (i.e., lead, asbestos, etc.). Every effort shall be made by the installation to ensure compliance with the clean site policy. Provide the date when the clean site will be available. Recycle building demolition and debris material when ever possible.

Construction Waste Management Plan required: Yes _____ No _____

For additional information, see Section 13.3.2 Waste Management of the IDG.

1.4 CONSTRUCTION GENERAL PERMIT

Is a Texas Pollutant Discharge Elimination System (TPDES) Construction General Permit required: Yes_____ No_____

For additional information, see Section 13.1 of IDG

1.5 HOT WORK PERMIT

A Hot Work Permit is required for any operation involving open flames and producing heat and/or sparks. Examples include, welding, burning, brazing, touch cutting soldering, grinding, etc. For additional information related to Hot Work permits contact 254-288-5820.

Hot Permit required: Yes _____ No _____

1.6 PAVING REQUIREMENTS

A. Parking area (s) required: Yes ____ No ____

1. Location and brief description: _____
2. Number of parking spaces for passenger vehicles: _____ (including _____ spaces for the handicapped).
3. Type of pavement: _____
4. Perimeter of parking area (s) to have concrete curb: Yes _____ No _____

5. Striping of parking spaces required: Yes _____ No _____

   a) Width of stripes: _____

   b) Type of paint to be used: _____

6. Special signage required: _____

7. Concrete wheel stops required: Yes _____ No _____

8. Handicapped ramps/depressed curbs required: Yes _____ No _____

For additional information, see Sections 9.2, 9.8, and 9.9 of the IDG.

B. Service road(s) required: Yes ____ No ____

1. Location: _____

2. Type pavement: _____

3. Concrete curbing required on both sides of road: Yes _____ No _____

4. Minimum roadway width: _____ feet _____

   List any other special paving considerations or needs: _____

   _____

   _____

   _____

For additional information, see Section 9.2 of the IDG.

C. Sidewalks required: Yes ____ No ____

1. Type of paving material: _____

2. Location: _____

3. Minimum width: _____

4. Minimum thickness shall be 4 inches with welded wire fabric.

For additional information, see Sections 9.2 and 9.12 of the IDG.

D. Concrete dumpster pads required: Yes ____ No ____

1. Number of pad (s): _____ each. See note below.

2. Size of each pad: _____ feet by _____ feet.

3. Provide bumper stops at rear of pads: Yes, _____ No _____

4. Provide architectural screening of pads: Yes, _____ No _____

Type: _____

NOTE: Building orientation or design may eliminate need for screening. Screening shall be in accordance with the Fort Hood Installation Design Guide.

1.7 UTILITIES SERVICE REQUIREMENTS

A. Electrical Service: Meter to the building with an electrical monitoring connection to a Meter Interface required:

Yes _____ No _____

Type: _____

1. Type system to be installed: underground _____ aerial_____

2. Type transformer (s) to be installed: Pole mtd., _____ Pad mtd. ____

NOTE: Screen in accordance with Army Installation Design Guide (IDG).

3. Available Voltage: _____

4. Location of tie-in point: _____

For additional information, see Sections 11.6.3 and 11.6.4 of the IDG.

B. Water Service: Meter to the building with an electrical monitoring connection to a Meter Interface required:

Yes _____ No _____

1. Size and location of tie-in point: _____

2. Additional fire hydrant (s) required: _____

For additional information, see Section 11.6.5 of the IDG.

C. Sanitary Sewer Service: Size and location of tie-in point: _____

_____

For additional information, see Section 11.6.5 of the IDG.

D. Storm Drainage:

1. Design for _____ year occurrence.

2. Type System: Surface _____ Underground_____

3. Location of tie-in point for existing underground storm drainage system if incorporated in contractor design: See Site Plan. ____

   _____

4. Have low-impact development (LID) principles for stormwater been incorporated in accordance with the IDG. Yes___ No___

For additional information, see Section 11.6.6 of the IDG.

E. Gas Service: Natural _____ Propane_____

Meter to the building with an electrical monitoring connection to a Meter Interface required: Yes _____ No _____

1. For Heating: Yes _____ No _____

2. For domestic hot water: Yes _____ No _____

3. For laundry dryers: Yes _____ No _____

4. For kitchen equipment: Yes _____ No _____

5. Size and location of tie-in point: _____

   _____

For additional information, see Section 11.6.7 of the IDG.

UTILITY NOTE:

Contractor (Offeror) shall be responsible to determine that all of the existing service utilities are of sufficient capacity to accommodate all of the design loads for this total facility. Should a Contractor (Offeror) determine that one or more of the existing service utilities are not adequate to accommodate the Contractor's (Offeror's) design loads for this total facility, then the Contractor (Offeror) shall submit with his initial and any subsequent proposal (Best & Final Offer), the requirements, design data and the price for increasing the capacity of each existing service utility system or for providing a new service utility system. Design loads for this facility shall be calculated in accordance with the criteria specified in this Request for Proposals (RFP), with the most stringent criteria governing. The responsibility for verification and field location of any and all information provided in the RFP and on any attached or enclosed drawings, or other documents shall be and is the responsibility of the Contractor (Offeror).

F. Coordination and Notification Required for Utilities Tie-in:

1. Point of contact for coordination: _____

   Telephone: _____ Email _____

2. Road Closing:

   a) Can both lanes be closed to traffic: Yes _____ No _____

   b) Maximum time road can be closed: _____

   c) Can road be closed over a holiday or weekend: Yes _____ No _____

   For additional information on road closing, see Section 15 of the IDG.

3. Minimum notification time required for utilities outages and road closing:

   a) Electric Power: _____ working days.

   b) Water: _____ working days.

   c) Gas: _____ working days.

   d) Steam: _____ working days.

   e) Central AC lines: _____ working days.

   f) Roads: _____ working days.

NOTE: Enclose underground primary electrical service in concrete from the new utility tie-in points to the pad mounted transformer and/or mechanical room panel boxes. Provide one spare conduit for each service sealed at both ends. The conduit may be PVC provided it conforms to NFPA 70, current edition.

NOTE: If existing sidewalk, curbs, gutters, or paving are disturbed or removed during construction, the paving or concrete must be replaced by the Contractor.

NOTE: At overseas installations, utility work must meet Host Nation codes. Notably, in Europe utilities connections shall comply with the supplier's local codes. Contractors in Europe shall meet local utilities provider's conditions.

G. Coordination and Notification Required for Railroad Track Work:

1. Point of contact for coordination: _____

   Telephone _____ Email _____

2. Road Closing:

   a) Can both lanes of traffic be closed: Yes _____ No _____

   b) Maximum time road can be closed: _____

   c) Can road be closed over a holiday or weekend: Yes _____ No _____

   For additional information on road closing, see Section 15 of the IDG.

3. Railroad Track Closing:

   a) Can track be closed to traffic: Yes _____ No _____

   b) Maximum time track can be closed: _____

   c) Can track be closed over holiday of weekend: Yes _____ No _____

4. Minimum notification time required for railroad track and road closing:

   a) Railroad track: _____ working days.

   b) Road: _____ working days.

5. Are used track components to be sorted and properly stored: Yes ____ No ____

6. Are samples, ultra-sonic inspections, temperature recordings, and certificates to be submitted for ties, rail track components, or ballast: Yes _____ No _____

7. Are RAILER markings and reporting required: Yes _____ No _____

8. Are there special radio or communication requirements: Yes_____ No _____

NOTE: If existing sidewalk, curbs, gutters, drainage, ballast, or paving are disturbed or removed during construction, the paving, drainage, ballast, or concrete must be replaced by the Contractor.

1.8 ARCHITECTURAL AND STRUCTURAL BUILDING DESIGN REQUIRMENTS

A. Seismic Design Zone: _____. Structural design shall be in accordance with codes specified in the RFP.

For additional information on seismic design, see Section 15 of the IDG.

B. Basic wind speed: _____ mph.

For additional information on climatic data, see appendix Q of the IDG.

C. Ground Snow Load: _____ PSF (Plus code live load).

D. LEED Compliance: If new construction or a major renovation, project meets or exceeds LEED-NC rating of SILVER.

Yes_____ No_____

E. Heat Transmission: "U" Factors:

1. Walls: _____.
2. Floor (slab-on-grade) at perimeter foundation wall: _____.
3. Floor over ventilated crawl spaces: _____.
4. Ceiling and/or roofs: _____.

F. Roof:

1. Minimum pitch: _____
2. Type: _____
3. Scuppers and drains are required: Yes (If a parapet type roof is proposed)_____ No _____
4. Gutters and downspouts: Yes _____Type: _____ No_____
5. Drainage carry off: Splash Blocks_____ or Underground drainage system (internal roof drains not permitted)_____
6. Access to roof: _____.

NOTE: Catwalks to and around rooftop HVAC units and other equipment are required (Cary tread or equal). Where possible, architectural screening of visible rooftop equipment is required.

For additional information on roofing, see Section 8.13.2.1 (Roofing) of the IDG.

G. Site Conditions:

For additional information on site planning/selection, see Section 7 of the IDG.

1. Environmental Assessment required: Yes_____ No _____

   Completion Date: _____ .

   Environmental Impact Statement required: Yes_____ No _____

   Completion Date: _____ .

   (Provide copies of actions to date.)

2. Cultural Resources Compliance completed: Yes _____ No _____

3. Site Conditions:

   Topographical feature description: _____

   _____

   _____

   _____

   Confirm or identify subterranean hazards:

   Fill area_____

   Old foundations _____

   Unexploded ordnance_____

   Existing/abandoned utility line_____

Tunnels/mines _____

Other _____

4. Soil investigation data available: Yes _____ No _____

At project location: Yes _____ No _____

Other: _____

5. Soil bearing capacity: PFS _____ Actual test _____

Assumed _____ .

NOTE: The successful Offeror shall be responsible for accomplishing additional necessary testing to verify soil characteristics at the site and design of the foundation system to meet these requirements.

H. Building Exterior: Brick: Yes _____ No _____ Other: _____

NOTE: Where brick is required, the exterior walls shall be finished with face brick with through body integral color and shall match the brick currently in place in Building No's _____

NOTE: The final floor plan as designed by Offerors shall include all functional areas outlined subsequently in this section. Gross building areas shall not exceed that specified in the RFP, including the mechanical room.

For additional information on building exterior design, see Appendices J and K of the IDG.

I. Barrier Free Requirements: (Where applicable) as minimum, _____ guest units shall be barrier free.

NOTE: Where required, "Barrier Free Requirements" shall be designed and constructed to provide for the Physically Handicapped (interior and exterior), in accordance with Uniform Federal Accessibility Standards (UFAS) and the Americans with Disabilities Act Accessibility Guidelines (ADAAG).

J. Kickplates required on interior wood doors: Yes _____ No _____

For additional information on interior doors, see Section 8.12.4.8 of the IDG.

K. Approximate total maximum occupancy:

1. Female: Adults _____ Children _____

2. Male: Adults _____ Children _____

3. TOTAL: _____ Comments: _____

_____

L. Landscape Requirements: List any special requirements: _____

_____

NOTE: Offerors will provide a Landscaping Plan for the project area as required in the RFP. Surface area disturbance and tree removal will be minimized. Trees determined to be retained will be incorporated in the Landscaping Plan. Landscaping shall refer to the planting of trees, shrubs, plants, etc. and shall not be associated with establishment of turf as defined below. Trees, shrubs, plants, etc. shall be guaranteed for a period of one (1) year from time of planting.

For additional information on landscaping, see Section 10 of the IDG.

M. Establishment of Turf: _____

For additional information on permitted turf, see Section 10.9.4 and Appendix N of the IDG.

NOTE: It will be the Contractor's responsibility to protect all existing turf and landscaping affected by the construction and to replace any turf or landscaping that has been damaged, for the term of the contract.

N. Soil Poisoning: For termite protection is _____ , is not _____ required.

For additional information on termite protection, see Section 8.15 of the IDG.

O. Paint Color: List standard paint colors: _____

_____

For additional information on building exterior design, see Appendices J and K of the IDG.

P. Finishes: List standard finishes: _____

_____

For additional information on building exterior design, see Appendices J and K of the IDG.

1.9 ELECTRICAL DESIGN REQUIREMENTS

A. Provide transient voltage surge suppression for all buildings having voltage-level sensitive electronic equipment such as computers. Yes _____ No _____

B. Exterior lighting:

For additional information on exterior lighting, see Section 11.5 of the IDG.

1. Parking area(s) lighting required: Yes_____ No _____

   a) Type of lighting: _____ Completed in accordance with Table 11-1 of the IDG

   b) Average Intensity: _____ foot candles per sq. yd. with a uniformity ratio of 4:1_____,
   Other _____ . (Avg. to min.)

   c) Type pole: _____

   d) Special mounting requirements: _____

   e) Type of Switching: _____ Manual

   _____ Clock 7 day 7 day

   _____ Astronomical

   _____ Photo Electric

   _____ Combination of above, as indicated.

   _____ Other

2. Exterior building lighting required: Yes_____ No _____

   a) Type of lighting: _____Completed in accordance with Table 11-1 of the IDG

   b) Average Intensity: foot candles per sq. yd.

   c) To be mounted on the building structure: Yes _____ No _____

   d) Switching:

      1) Type: _____ Manual

      _____ Clock 7 day 7 day

      _____ Astronomical

_____ Photo Electric

_____ Combination of above, as indicated.

_____ Other

2) Location: _____

3) Lighting for plumbing and electrical chases required: Yes_____ No _____

NOTE: All electrical wiring (exterior and interior) shall be copper.

C. Outside weather proof receptacles: shall be installed every _____ feet along the building exterior. Outside weather proof receptacles should be RCD (GFCI) protected.

NOTE: The building shall have emergency light fixtures and exit lights in accordance with NFPA requirements. Both shall have battery powered back-up, charge level meters and test buttons.

D. Electromagnetic Shielding: List any electromagnetic shielding requirements._____

_____

E. Standby/Backup Power Requirements: List and standby/backup power requirements. _____

_____

1.10 MECHANICAL HEATING AND COOLING DESIGN REQUIREMENTS

For additional information on mechanical heating and cooling design, see Section 8.14.1 and Appendix Q of the IDG.

A. Heating design data:

1. Below is the outside dry bulb temperature that is equaled or exceeded 97½ percent of the time, on the average, during the coldest 3 consecutive months (Dec., Jan., and Feb.). Heating design shall be based on the dry bulb temperature equaled or exceeded 97½ percent of the time.

   a) Dry bulb temperature: _____

   b) Wind velocity: _____

   c) Degree days: _____

2. Interior design temperatures: 68 degrees.

B. Air conditioning design data:

1. Outside dry bulb and wet bulb temperatures that are equaled or exceeded 2 ½ percent of the time, on the average, during the warmest 4 consecutive months (Jun. thru Sep.) are given below. Air conditioning design shall be based on the 2 ½ percent dry bulb, wet bulb temperature.

   a) Dry bulb temperature: _____

   b) Wet bulb temperature: _____

2. Interior design temperatures: _____

   a) Dry bulb temperature: _____

   b) Wet bulb temperature: _____

C. Heating and air conditioning system: shall be designed to provide a relative humidity of 50% + 10% or -10%.

D. Mechanical Systems: Economy cycle. The air conditioning system except where room fan coil units are located, if located where the winter design dry bulb temperature is 35 degrees F (97 ½% basis) or less, shall be designed so that 100% outside air may be used in the system during those cool weather periods when the outside air temperature is sufficiently low to provide all the cooling needed, or reduce the load on the air conditioning refrigeration equipment. Use of the economy cycle in areas above 35° F shall be provided when it can be clearly shown that use of the economy cycle is cost effective.

E. Install humidity control override: Yes _____ No _____

F. Automatic timer controls required for:

1. Heating System: Yes _____ No _____

2. Air Conditioning System: Yes _____ No _____

G. Heating and Air Conditioning Source:

1. Self contained plant: Heat _____ AC _____

2. Supply lines from central plant: Heat _____ AC _____

3. Purchased heat: _____

H. Low profile roof mounted HVAC units are permissible: Yes _____ No _____

I. Automatic timer controls required for:

1. Heating System: Yes_____ No _____

2. Air Conditioning System: Yes_____ No _____

J. Heating fuel to be used: ____ Natural gas

____ #2 Fuel oil

_____Propane

K. Dual fuel heating plant required: Yes _____ No _____

Primary Fuel _____ Secondary Fuel_____

L. Outside air supply intake: to close when building is unoccupied: Yes _____ No_____

M. Type heating and air conditioning filters required: Permanent_____ Throw away_____

N. Covers and locks: required on interior utilities controls: Yes _____ No_____

1.11 PLUMBING DESIGN REQUIREMENTS

For additional information on plumbing design requirements, see Section 8.14.3 of the IDG.

Plumbing Design Data (includes drinking water and sanitary sewer):

NOTE: Sewage systems will be designed for compliance with TAC Chapter 317 Design Criteria for Sewage Systems, which sets minimum standards necessary for domestic wastewater treatment systems to function properly and meet requirements for effluent quality. The criteria also contain certain safety standards.

NOTE: Drinking water systems will be designed for compliance with TAC Chapter 290, Public Drinking Water, which provides for, among other requirements, rules, and regulations for public water systems.

NOTE: All plumbing work shall be conducted in accordance with the 2003 International Plumbing Code.

NOTE: Backflow Prevention: Backflow prevention assemblies shall be installed in accordance with the requirements of the TAC (Texas Administrative Code) Title 30 Environmental Quality, Part 1 TCEQ, Chapter 290 Public Drinking Water, Sub Chapter D Rules and Regulations for Public Water Systems, Rule 290.44 Water Distribution Rule 290.46, and 290.47. The TCEQ (Texas Commission on Environmental Quality) administers all rules of the TAC. All backflow prevention assemblies that are installed on Fort Hood, Texas. will be tested upon installation by a licensed backflow assembly tester certified by the TCEQ. The original signed and dated test reports will be turned into the DPW, Chief of Services Division Building #4612-A, Engineer Drive, Fort Hood, Texas. The backflow assemblies will be installed not less than 36 inches above the ground, not greater than 42 inches above the ground, and will be located not less than 12 inches from any wall. The assemblies will not be installed where they obstruct access to any mechanical components or near electrical components.

NOTE: Customer Service Inspections: Before continuous water can be provided, Texas law requires an inspection of a private water distribution system as a way to insure the water is safe to drink. The customer service inspection is used to identify two potential sources of contamination. One is a cross-connection—an actual or potential connection between a possible source of contamination or pollution and the other source is lead associated with plumbing materials. Customer service inspections will be performed by plumbing inspectors, customer service inspectors licensed by the TCEQ, and water supply protection specialists licensed by the Texas State Board of Plumbing Examiners. The original inspection reports will be turned into the DPW, Chief of Services Division at Building #4612-A, Engineer Drive, Fort Hood, Texas. TAC Title 30, Chapter 290, Subchapter D, Section 290.46 provides guidance to better understand the requirements of customer service inspections.

1. Exterior hose bibs: Minimum of _____ each with ¾-inch hose connection on building exterior.

   a) Frost protection required: Yes _____ No _____

   b) Removable cutoff handles required: Yes _____ No _____

2. Interior hose bibs: See Functional Requirements

3. Grease trap(s) required: Yes_____ No _____ Location (s):_____

4. Commodes shall be floor mounted flush valve type.

5. Lift station required: Yes_____ No _____

6. Hot water heater(s) required: Yes _____ No _____

   a) Energy source: Natural gas _____ #2 Fuel oil_____

   b) Required minimum temperature: _____

   c) System: _____

   NOTE: All domestic water piping below grade shall be type K copper. All domestic water piping above grade shall be either type L copper in accordance with appropriate codes. All joints shall be soldered with 95/5 Tin/Antimony solder. The entire potable water system shall be lead free. Vent piping shall be schedule 40 galvanized steel or DWV weight copper.

7. Provide a minimum of _____ floor drain(s) in the laundry and mechanical room.

8. Insulate all water pipes (hot & cold) above slab: Yes_____ No _____

   NOTE: The domestic hot and cold water piping below grade shall be kept to a minimum, and below the frost line if located outside the building perimeter.

9. All domestic water pipes (hot & cold) shall be stenciled HW or CW. If pipes have been insulated then the pipe insulation shall also be stenciled.

10. Provide grease interceptor: Yes_____ No _____ Location: _____

11. Provide a water filtration system: Yes_____ No _____

    Location: _____

    Type: _____

12. Other plumbing considerations or requirements: _____

    _____

1.12 REFUSE CONTAINER ENCLOSURE REQUIREMENTS

Refuse Container Required: Yes_____ No_____

Refuse containers are front-end loaded. They should be located where they are not likely to be blocked and their distance from occupied structures must be in accordance with security requirements (see Section 12 of the IDG). The refuse truck needs a minimum of 75-foot clearance in front of the container. When more than one container is located within a screened area, clearance between containers must be 2 feet.

Overall Dimensions:

For one container, the area must be 8 feet by 12 feet. Dimensions for an area containing two containers are 8 feet by 21 feet. In all cases, containers should be 3 feet from the side of the screening structure. In no case should the refuse collection area be designed such that the collection vehicle must back out of the access point from which it came.

For additional information on refuse enclosure requirements, see Section 11.3.2.8 of the IDG.

1.13 COMMISSION REQUIREMENTS

The following building systems shall be commissioned:

_____Mechanical System over 10 Tons

_____All HVAC and other mechanical systems, Explain_____

_____Building envelope technologies;

_____ Interior and exterior lighting and controls;

_____ Daylighting systems;

_____Plumbing fixtures and plumbing infrastructure;

_____Irrigation and rainwater harvesting systems;

_____Water treatment systems; and

_____Other advanced performance technologies, Explain_____

2.0 MINIMUM REQUIREMENTS FOR RESTROOMS

The following criteria are for minimal requirements only and may be superseded in quantities and/or finishes, providing that changes are an upgrading of the minimal requirements. For additional information on plumbing design requirements, see Section 8.14.3 of the IDG.

A. General: MEN'S and WOMEN'S

Item	Quantity	Special Requirements
Lavatory		
Commode		
Faucets		Chrome finish.
Expose pipes/valves		Chrome finish.
Pipe penetrations		Chrome finish escutcheons.
Clean outs		Chrome covers.
Mirrors		Mech. wall fasteners.
Lighting		

Item	Quantity	Special Requirements
Floor drain		Each restroom.
Hose bib		Under lavatory in each restroom.
Wall finish	n/a	Ceramic tile to 5-foot height.
Ceiling	n/a	Moisture-resistant DW.
Floors	n/a	Ceramic tile w/ceramic tile base, or quarry tile w/quarry tile base. Tile shall be MUD-SET.
Toilet Partitions		At all commodes and urinals. Overhead braced w/door bumpers and w/skirts.
Skirts		18-inch stainless steel. Watertight top edge.
Duplex receptacle		GFCI type over vanity.
Paper towel dispenser with trash receptacle		Recessed in wall. [1]
Hand dryer		Over each lavatory.
Soap dispenser		Liquid pump.
Toilet paper dispenser		Each commode stall. [1]
Ash receptacle		Recessed, each restroom.

B. Specific: WOMEN'S

Item	Quantity	Special Requirements
Sanitary napkin disposal		Each commode stall.
Sanitary napkin disposal		Each restroom, coin operated.

C. Specific: MEN'S

Item	Quantity	Special Requirements
Urinal		Porcelain wall-mounted w/stainless steel part.

NOTES: Each restroom shall be designed and constructed with provisions for the handicapped and shall conform to the latest edition of the National Standard Plumbing Code and the Uniform Federal Accessibility Standards published in the Federal Register, August 7, 1984 (Current Edition).

[1] In restrooms, washrooms, and utility rooms where towels and toilet paper dispensers are installed use the jumbo size dispensers. Paper towel dispensers are typically sized to dispense 7.75- to 8.5-inch by 800-foot rolls. The toilet tissue dispensers are to be twin roll holders and typically sized to dispense 9-inch diameter or 1,000 sheet rolls.

Styles of dispensers are to be comparable to San Jamar Classic dispensers (or equal), or Georgia Pacific Twin brand toilet tissue and Towelmaster towel dispensers (or equal). Toilet tissue and paper towel dispensers are to be matched design.

3.0 FIRE PROTECTION REQUIREMENTS

All new construction renovations modernization or changes in occupancy shall be required to comply with the current UFC 3-600-01, Design: Fire Protection Engineering for Facilities. All fire protection requirement questions should be directed to 254-288-5820.

For additional information on Fire Protection, see Section 8.14.8 of the IDG.

A. Sprinkler system required: Yes _____ No _____

1. Type system to be installed: Wet_____ Dry_____

2. Complete coverage throughout the structure: Yes_____ No_____

   If no, describe proposed system, layout, etc.:_____

3. Exterior siamese connections are required.

NOTES:

Sprinklers

- All wet pipe sprinkler systems shall be installed in accordance with the current National Fire Protection Association's (NFPA) NFPA 13, *Installation of Sprinkler Systems*;
- All dry pipe sprinkler systems shall be installed in accordance with the current NFPA 13 and shall have a floor-mounted compressor; and
- Sprinkler system submittals shall be reviewed by the Fort Hood Fire Prevention Office before installation.

Kitchen fire suppression systems

- All suppression systems shall be installed in accordance with the current NFPA 17, *Standard for Dry Chemical Extinguishing Systems*, and current NFPA 17A, *Standard for Wet Chemical Extinguishing Systems*.

B. Detection System

1. Smoke detectors required: Yes _____ No _____

   NOTE: Radium type shall not be used.

2. Heat detectors required: Yes _____ No _____

(Rate of Rise Heat Detectors shall not be permitted.)

NOTE: When smoke and heat detectors are specific, full coverage of the building is required. In addition, heat detectors are also to be installed in conjunction with potential fire producing equipment such as furnaces, electric motors, etc. All detection devices shall be spaced and installed in accordance with manufacturer's specifications and the latest edition of the NFPA in effect at the time of installation. Heat detectors shall be set to trigger at 135 degrees F. The heat and smoke detectors shall be the combination type. The smoke detection unit shall alarm locally and the heat detection unit shall alarm the facility and transmit the alarm to the fire department via a dedicated telephone line or appropriate transmission media, i.e. radio transmission equipment. Automatic cutoff of air handling equipment is required when smoke or heat detectors, sprinkler systems, or any other automatic/manual fire alarm suppression system are activated.

C. Fire Alarm System

- Fire alarm systems shall be Class A systems;
- Fire alarm systems shall be keyed alike with CAT-15 keys;
- All pull stations shall be keyed alike with CAT-15 keys and reset. Break glass or rods, or special tools shall not be required to reset;
- MONACO BTXF Transmitters shall be used;
- Knox boxes shall be installed (direct questions to 254-288-5820);
- Fire alarm systems shall be installed in accordance with the current National Fire Protect Association (NFPA) 72 and the manufacturer's instructions;
- Combination smoke/heat detectors shall be used on all barrack or sleeping facilities; and
- All fire alarm submittals shall be reviewed by the Fort Hood Fire Prevention Office before installation.

D. Special fire suppression system (s) required: Yes_____ No _____

Describe type, location, and justification: _____

_____

E. Fire extinguishers (manually operated) are required.

1. Government furnished: Yes _____ No _____

2. Quantity and locations shall be based upon building design, NFPA, requirements, and coordinated with Installation's fire department.

3. Recessed cabinet mounted: Yes _____ No _____

NOTES: (1) The Contractor (Offeror) shall furnish and install the recessed fire extinguisher cabinets. The cabinets shall be at a minimum of 24.5 inches tall, 7 inches deep, and 8.5 inches wide with glass doors.

(2) Ensure that each building has a sign with the building number on it and each is equipped with proper fire extinguishers. DPW, DES-Fire & Emergency Services will no longer provide fire extinguishers.

F. Fire Department Access

Design for fire department access to structures must comply with the most current UFC 3-600-01 and NFPA 18. Access questions should be directed to 254-288-5820.

G. All interior finish materials shall be per NFPA standards and Military Handbook 1008C.

H. Water supply lines for the sprinkler system shall be black steel pipe.

I. The installation's standard fire alarm panels shall be specified for ease of maintenance and sustainability.

J. Emergency Lighting Requirements.

4.0 SECURITY REQUIREMENTS

A. Building physical security:

1. Intrusion detection system required: Yes_____ No_____

   a) Type system to be installed:_____

   b) Desired location of detectors:_____

   c) Exterior door alarm requirements: _____

   d) Exterior window alarm requirements: _____

2. Duress alarm system (s) required: Yes_____ No_____

   a) Type system to be installed:_____

   b) Location (s): _____

B. Safe (s) required: Yes _____ No_____

1. Type and Number: _____

2. Size:_____

3. Location(s): _____

4. Secure to building: Yes ____ No _____ If yes, how: _____

5. Connect to main intrusion alarm system: Yes_____ No_____

C. Remote transmission of the intrusion alarm system: to the installations master system required: Yes_____ No _____
If yes, provide and install the transmitter, all conduit, wiring, hookups from the intrusion alarm devices to the transmitter, as well as all exterior underground conduit, required wiring, panel boxes and all other ancillary equipment to bring the system to the existing communication transmission lines. The final connection at the communication line will be made by the government. All systems proposed shall be compatible with the existing system (s) installed at the installation. Point of coordination is Provost Marshall's Physical Security Officer. Specify the installation's standard intrusion alarm system if required.

For additional information on telecommunication requirements, see Section 8.14.7.2 of the IDG.

D. Keying requirements:

1. Rooms requiring card readers: _____

2. Rooms requiring cipher locks: _____

3. Rooms requiring individual keys:_____

4. Rooms requiring master keys:_____

5. Exterior keying requirements: _____

6. At least six (6) keys shall be provided for each lock. An additional twelve (12) sub master and six (6) master keys shall be provided.

7. The Offeror shall provide fifty (50) key blanks in addition to the above keying requirements.

For additional information on door hardware, locks, and locking devices see Section 8.14.9.

E. All exterior doors shall have hinge pins that cannot be removed.

F. Panic hardware shall be in accordance with NFPA requirements.

G. Hardened secure area (s) required: Yes ____ No ____

Location(s): _____

H. Fencing Requirements:

1. Location: _____

2. Type and height: _____

3. Gate requirements: _____

For additional information on fences, see Section 11.2.3.7 of the IDG.

I. Antiterrorism Requirements:

1. Blast-resistant windows: _____

2. Setbacks: _____

3. Barriers: _____

4. Others: _____

J. Risk/Threat Analysis Requirements:

For the project, provide unclassified information from the risk/threat analysis: _____

_____

_____

_____

5.0 COMMUNICATIONS REQUIREMENTS

For additional information on telecommunication requirements, see Section 8.14.7.2 of the IDG.

A. Intercom system required: **Yes** ____ **No** ____

Give a brief description of the requirements for the system: _____

_____

B. Music/Paging system required: **Yes** ____ **No** ____

Give a brief description of the requirements for the system: _____

_____

C. Telephone system required: **Yes** ____ **No** ____

1. Location: _____

2. Type: _____

3. Pay telephone required: Yes ___ No _____ If required, unit(s) will be wall hung. Contractor shall run wire and conduit from pay phone outlets to the main panel. Phones to be provided by Contractor.

   NOTE: Contractor shall provide all conduit, wire, junction boxes and pull wires for the telephone system as required. Hookup of the telephone system will be performed by the Contractor. The Contractor shall coordinate all the telephone requirements with the installation's Directorate of Public Works (DPW) office and the local telephone company to determine requirements and provide space for communication equipment, panels, etc., in the mechanical room of where otherwise designed.

4. The basic telephone system shall be the “Centrax System” as provided by: _____

5. The system functions shall include the following:

   a) Direct in dialing, with restrictions on receiving collect calls.

   b) Direct out dialing to local exchange number only.

   c) Restrictions on placing chargeable calls outside the local exchange, except for calls charged to credit card or calls made with the charges reversed.

D. Television system required: **Yes** ____ **No** ____

1. The technical and installation requirements of the television system shall be coordinated with _____ , the local cable television provider.

2. Locations/number of internal outlets: _____

3. Wiring and grounding shall be in accordance with the National Electric Code.

E. Mass Notification System (Required per UFC 4-010-01, Standard 23: for New Inhabited Buildings and for Existing Buildings (Primary Gathering and Billeting), also for Existing Buildings, Recommended for all Inhabited Buildings)

Type of Mass Notification System Required: Fire prevention/mass notification questions should be directed to: 254-287-4915

6.0 SIGNAGE REQUIREMENTS

(Excluding those required by NFPA and OSHA)

A. Interior signage:_____

B. Exterior Signage: _____

For additional information exterior signage requirements, see Section 11.4 of the IDG.

NOTE: All exterior signage shall conform to the Army Installation Design Guide and Post Wide Paint/Exterior Finish Standards and color charts.

7.0 OTHER COMMENTS

_____

_____

_____

APPENDIX C

Interior Design Review Checklist

It is recommended that the Interior Design Review Checklist be used during review of a Request for Proposal (RFP) submission or an AE or in-house design prior to solicitations for major projects.

Interior Design Review Checklist		
1. Installation	**Project**	**Date**
Job Description		
Building No.	Building Cost $	
Evaluator	Furnishing Cost $	
Using Agency Coordinator		Phone #
Designer		Phone #

Item	Yes	No	N/A
2. Is the interior design integral to the facility design?			
▸▸ Interior design is specified by the using agency.			
▸▸ Scope of work includes building related interior design.			
▸▸ Scope of work includes furniture related interior design.			
▸▸ Design incorporates Army Installation Design Guide and Standards criteria.			
▸▸ DPW representative was a member of Pre-selection and/or Selection Boards.			
Preselection member:			
Selection member:			
3. Was the designer provided interior design criteria?			
▸▸ Designed Guide for Interiors DG 1110-3-122.			
▸▸ Design Guide for facility type designed.			
▸▸ Army Installation Design Guide and Standards.			
4. The design has been reviewed and the following are acceptable?			
For building related interior design?			
▸▸ Statement of Design Objective			
▸▸ Sketches			
▸▸ Color Board			
▸▸ Furniture Plan			
▸▸ Exterior Materials and Finishes			
▸▸ Graphic Design			
▸ Hand Drawn Sketches			
▸ Digital image files (JPG, BMP, etc.)			
▸ 3D Model			
▸ Animation (AVI, etc.)			

Item	Yes	No	N/A
▸▸ Interior Design Finish Schedule			
▸▸ Government Furnished Material List			
Items for Installation of Furniture and Accessories			
▸▸ Predesign Evaluation:			
▸ Maintenance Data			
▸ Floor Systems			
▸ Electrical Equipment and Task/Supplemental Lighting			
▸▸ Interior Element Specification			
▸ Cost Estimates:			
▸ Maintenance and Repair			
▸ New Work			
▸ Equipment-in-place and Furnishings			
For furniture related interior design			
▸▸ Typical furniture layout			
▸▸ Furnishing, fabrics and finishes board			
▸▸ Furnishings plan			
▸▸ Sketch perspectives			
▸▸ Colored rendering			
▸▸ Photographs			
▸▸ Catalog Cuts			
▸▸ Furnishing illustration sheets			
▸▸ Furnishing placement lists			
▸▸ Furnishing order forms			
▸▸ Furnishing contract specifications			

Item	Yes	No	N/A
5. Does the interior design address the following functions?			
▸▸ Communications			
▸▸ Storage/filing			
▸▸ Display surfaces			
▸▸ Work surfaces			
▸▸ Conference Space(s)			
▸▸ Privacy			
▸▸ Lighting			
▸▸ Planting			
▸▸ Spatial considerations			
▸▸ Color/texture characteristics			
▸▸ Reflectance values			
▸▸ Acoustical considerations			
▸▸ Mechanical fixture placement			
▸▸ Electronic support			
▸▸ Furnishings/accessories			
▸▸ Work, training or paper flow			
▸▸ Hardware selection			
▸▸ Graphics/signage			
▸▸ Force Protection			
▸▸ Physical Security			
▸▸ Fire Safety			
6. Construction and installation phase			
▸▸ Positive first impression is created			
▸▸ Coordinated color scheme, interior reflecting exterior			
▸▸ Area & shape of spaces match function & support mission			

Item	Yes	No	N/A
▸▸ Furnishings support function of space			
▸▸ Creative use of interior design spaces			
▸▸ Retained designer to review and approve contractor submittals			
▸▸ Retained designer to oversee the installation of furnishings			
▸▸ Color boards were required and reviewed			
▸▸ Interior appearance policy is implemented			
Describe actions taken to ensure quality interior design to all negative responses on an attached sheet. Maintain a copy of this interior design review checklist and all negative responses in the DPW project file.			
I hereby certify that the information provided is in compliance with the guidelines of the installation or applicable IDG, except as justified as non-compliance.			
Designer of Record	**Date**		
Concur			
Deny (Explanation of denial is attached.)			
Master Planner	**Date**		
Accept			
Deny (Explanation of denial is attached.)			
Command Review (Where Applicable)	**Date**		

APPENDIX D

LEED Checklist

The Fort Hood LEED Checklists for New Construction (NC), Existing Buildings (EB), and LEED-HOMES are included in this appendix. For more information on LEED see Section 1 of this IDG. You may also visit the U.S. Green Building Council website at www.usgbc.org or contact the Fort Hood LEED Coordinator, DPW – Environmental at (254) 287-6499 for more information.

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D.1 LEED-NC (NEW CONSTRUCTION) CHECKLIST

LEED-NC Version 2.2 Project Checklist[1]

Target LEED Project Points
Fort Hood, TX

Credit	Description	LEED Point(s)	Fort Hood Target Point[2]	Completed
Sustainable Sites (SS)		Total **14** Points		
Prerequisite 1	**Construction Activity Pollution Prevention**	Required	YES	
Credit 1	**Site Selection**	1	YES	
Credit 2	**Development Density & Community Connectivity**	1	OPTIONAL	
Credit 3	**Brownfield Redevelopment**	1	NO	
Credit 4.1	**Alternative Transportation**, Public Transportation Access	1	NO	
Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1	YES	
Credit 4.3	**Alternative Transportation**, Low-Emitting and Fuel-Efficient Vehicles	1	YES	
Credit 4.4	**Alternative Transportation**, Parking Capacity	1	YES	
Credit 5.1	**Site Development**, Protect of Restore Habitat	1	OPTIONAL	
Credit 5.2	**Site Development**, Maximize Open Space	1	YES	
Credit 6.1	**Stormwater Design**, Quantity Control	1	OPTIONAL	
Credit 6.2	**Stormwater Design**, Quality Control	1	OPTIONAL	
Credit 7.1	**Heat Island Effect**, Non-Roof	1	YES	
Credit 7.2	**Heat Island Effect**, Roof	1	YES	
Credit 8	**Light Pollution Reduction**	1	YES	

LEED-NC Version 2.2 Project Checklist[1]

Target LEED Project Points
Fort Hood, TX

Credit	Description	LEED Point(s)	Fort Hood Target Point[2]	Completed
Water Efficiency (WE)		Total **5** Points		
Credit 1.1	**Water Efficient Landscaping**, Reduce by 50%	1	YES	
Credit 1.2	**Water Efficient Landscaping**, No potable Use or No Irrigation	1	YES	
Credit 2	**Innovative Wastewater Technologies**	1	OPTIONAL	
Credit 3.1	**Water Use Reduction**, 20% Reduction	1	YES	
Credit 3.2	**Water Use Reduction**, 30% Reduction	1	OPTIONAL	
Energy & Atmosphere (EA)		Total **17** Points		
Prerequisite 1	**Fundamental Commissioning of Building Energy Systems**	Required	YES	
Prerequisite 2	**Minimum Energy Performance**	Required	YES	
Prerequisite 3	**Fundamental Refrigerant Management**	Required	YES	
Credit 1	**Optimize Energy Performance**	1 to 10	YES	
Credit 2	**On-Site Renewable Energy**	1 to 3	OPTIONAL	
Credit 3	**Enhanced Commissioning**	1	OPTIONAL	
Credit 4	**Enhanced Refrigerant Management**	1	YES	
Credit 5	**Measurement & Verification**	1	YES	
Credit 6	**Green Power**	1	OPTIONAL	
Materials & Resources (MR)		Total **13** Points		

LEED-NC Version 2.2 Project Checklist[1]

Target LEED Project Points
Fort Hood, TX

Credit	Description	LEED Point(s)	Fort Hood Target Point[2]	Completed
Prerequisite 1	**Storage & Collection of Recyclables**	Required	YES	
Credit 1.1	**Building Reuse**, Maintain 75% of Existing Walls, Floors & Roof	1	OPTIONAL	
Credit 1.2	**Building Reuse**, Maintain 100% of Existing Walls, Floors & Roof	1	OPTIONAL	
Credit 1.3	**Building Reuse**, Maintain 50% of Interior Non-Structural Elements	1	OPTIONAL	
Credit 2.1	**Construction Management**, Divert 50% from Disposal	1	YES	
Credit 2.2	**Construction Management**, Divert 75% from Disposal	1	OPTIONAL	
Credit 3.1	**Materials Reuse**, 5%	1	OPTIONAL	
Credit 3.2	**Materials Reuse**, 10%	1	OPTIONAL	
Credit 4.1	**Recycled Content**, 10% (post-consumer + ½ pre-consumer)	1	YES	
Credit 4.2	**Recycled Content**, 20% (post-consumer + ½ pre-consumer)	1	YES	
Credit 5.1	**Regional Materials**, 10% Extracted, Processed & Manufactured Regionally	1	YES	
Credit 5.2	**Regional Materials**, 20% Extracted, Processed & Manufactured Regionally	1	YES	
Credit 6	**Rapidly Renewable Materials**	1	YES	
Credit 7	**Certified Wood**	1	YES	
Indoor Environmental Quality (EQ)		Total **15** Points		
Prerequisite 1	**Minimum IAQ Performance**	Required	YES	
Prerequisite 2	**Environmental Tobacco Smoke (ETS) Control**	Required	YES	
Credit 1	**Outdoor Air Delivery Monitoring**	1	YES	

LEED-NC Version 2.2 Project Checklist[1]

Target LEED Project Points
Fort Hood, TX

Credit	Description	LEED Point(s)	Fort Hood Target Point[2]	Completed
Credit 2	**Increased Ventilation**	1	YES	
Credit 3.1	**Construction IAQ Management Plan**, During Construction	1	YES	
Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy	1	YES	
Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1	YES	
Credit 4.2	**Low-Emitting Materials**, Paints & Coatings	1	YES	
Credit 4.3	**Low-Emitting Materials**, Carpet Systems	1	YES	
Credit 4.4	**Low-Emitting Materials**, Composite Wood & Agrifiber Products	1	YES	
Credit 5	**Indoor Chemical & Pollutant Source Control**	1	YES	
Credit 6.1	**Controllability of Systems**, Lighting	1	OPTIONAL	
Credit 6.2	**Controllability of Systems**, Thermal Comfort	1	OPTIONAL	
Credit 7.1	**Thermal Comfort**, Design	1	OPTIONAL	
Credit 7.2	**Thermal Comfort**, Verification	1	OPTIONAL	
Credit 8.1	**Daylight & Views**, Daylight 75% of Spaces	1	YES	
Credit 8.2	**Daylight & Views**, Daylight 90% of Spaces	1	OPTIONAL	
Innovation & Design Process (ID)		Total **5** Points		
Credit 1.1	**Innovation in Design**, Provide Specific Title	1	OPTIONAL	
Credit 1.2	**Innovation in Design**, Provide Specific Title	1	OPTIONAL	

LEED-NC Version 2.2 Project Checklist[1]

Target LEED Project Points
Fort Hood, TX

Credit	Description	LEED Point(s)	Fort Hood Target Point[2]	Completed
Credit 1.3	**Innovation in Design**, Provide Specific Title	1	OPTIONAL	
Credit 1.4	**Innovation in Design**, Provide Specific Title	1	OPTIONAL	
Credit 2	**LEED® Accredited Professional**	1	YES	
Total Points				
	Total	**69**	**Need > 33**	

Army regulations require that a minimum of LEED-NC SILVER (>33 points) needs to be met for all new construction or major renovation projects:
Silver 33-38 points
Gold 39-51 points
Platinum 52-69 points

Notes:
[1] *Table created February 27, 2007; Reference LEED-NC Reference Guide Version 2.2, First Edition October 2005.*
[2] *Identifies those points that Fort Hood is targeting to meet LEED-NC SILVER. Those identified with:*
YES *– will be required by Fort Hood.*
NO *– will not be required by Fort Hood*
OPTIONAL *– including credit is at the discretion of the project manager (must ensure that total points is greater than 33 points).*

For more information on LEED visit the U.S. Green Building Council website at www.usgbc.org or contact the Fort Hood LEED Coordinator, DPW – Environmental at (254) 287-6499 for more information.

D.2 LEED-EB (EXISTING BUILDING) CHECKLIST

LEED-EB Version 2.0 Project Checklist[1]

Target LEED Project Points
Fort Hood, TX

Credit	Description	LEED Point(s)	Fort Hood Target Point[2]	Completed
Sustainable Sites (SS)		Total **14** Points		
Prerequisite 1	**Erosion & Sediment Control**	Required	OPTIONAL	
Prerequisite 2	**Age of Building**	Required	OPTIONAL	
Credit 1.1	**Plan for Green Site & Building Exterior Management**, 4 Specific Actions	1	OPTIONAL	
Credit 1.2	**Plan for Green Site & Building Exterior Management**, 8 Specific Actions	1	OPTIONAL	
Credit 2	**High Development Density Building & Area**	1	OPTIONAL	
Credit 3.1	**Alternative Transportation**, Public Transportation Access	1	OPTIONAL	
Credit 3.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1	OPTIONAL	
Credit 3.3	**Alternative Transportation**, Alternative Fuel Vehicles	1	OPTIONAL	
Credit 3.4	**Alternative Transportation**, Car Pooling & Telecommuting	1	OPTIONAL	
Credit 4.1	**Reduced Site Disturbance**, Protect or Restore Open Space (50% of site area)	1	OPTIONAL	
Credit 4.2	**Reduced Site Disturbance**, Protect or Restore Open Space (75% of site area)	1	OPTIONAL	
Credit 5.1	**Stormwater Management**, 25% Rate and Quantity Reduction	1	OPTIONAL	
Credit 5.2	**Stormwater Management**, 50% Rate and Quantity Reduction	1	OPTIONAL	
Credit 6.1	**Heat Island Reduction**, Non-Roof	1	OPTIONAL	
Credit 6.2	**Heat Island Reduction**, Roof	1	OPTIONAL	
Credit 7	**Light Pollution Reduction**	1	OPTIONAL	
Water Efficiency (WE)		Total **5** Points		

LEED-EB Version 2.0 Project Checklist[1]

Target LEED Project Points
Fort Hood, TX

Credit	Description	LEED Point(s)	Fort Hood Target Point[2]	Completed
Prerequisite 1	**Minimum Water Efficiency**	Required	OPTIONAL	
Prerequisite 2	**Discharge Water Compliance**	Required	OPTIONAL	
Credit 1.1	**Water Efficient Landscaping**, Reduce Potable Water Use by 50%	1	OPTIONAL	
Credit 1.2	**Water Efficient Landscaping**, Reduce Potable Water Use by 95%	1	OPTIONAL	
Credit 2	**Innovative Wastewater Technologies**	1	OPTIONAL	
Credit 3.1	**Water Use Reduction**, 10% Reduction	1	OPTIONAL	
Credit 3.2	**Water Use Reduction**, 20% Reduction	1	OPTIONAL	
Energy & Atmosphere (EA)		Total **23** Points		
Prerequisite 1	**Existing Building Commissioning**	Required	YES	
Prerequisite 2	**Minimum Energy Performance**, Energy Star 60	Required	YES	
Prerequisite 3	**Ozone Protection**	Required	YES	
Credit 1	**Optimize Energy Performance**	1 to 10	YES	
	Energy Star Rating - 63	1	OPTIONAL	
	Energy Star Rating – 67	2	OPTIONAL	
	Energy Star Rating – 71	3	OPTIONAL	
	Energy Star Rating – 75	4	OPTIONAL	
	Energy Star Rating – 79	5	OPTIONAL	
	Energy Star Rating – 83	6	OPTIONAL	
	Energy Star Rating – 87	7	OPTIONAL	

LEED-EB Version 2.0 Project Checklist[1]

Target LEED Project Points
Fort Hood, TX

Credit	Description	LEED Point(s)	Fort Hood Target Point[2]	Completed
	Energy Star Rating – 91	8	OPTIONAL	
	Energy Star Rating – 95	9	OPTIONAL	
	Energy Star Rating - 99	10	OPTIONAL	
Credit 2.1	**Renewable Energy**, On-site 3%/Off-site 15%	1	OPTIONAL	
Credit 2.2	**Renewable Energy**, On-site 6%/Off-site 30%	1	OPTIONAL	
Credit 2.3	**Renewable Energy**, On-site 9%/Off-site 45%	1	OPTIONAL	
Credit 2.4	**Renewable Energy**, On-site 12%/Off-site 60%	1	OPTIONAL	
Credit 3.1	**Building Operation & Maintenance**, Staff Education	1	OPTIONAL	
Credit 3.2	**Building Operation & Maintenance**, Building Systems Maintenance	1	OPTIONAL	
Credit 3.3	**Building Operation & Maintenance**, Building Systems Monitoring	1	OPTIONAL	
Credit 4	**Additional Ozone Protection**	1	OPTIONAL	
Credit 5.1	**Performance Measurement**, Enhanced Metering (4 specific actions)	1	OPTIONAL	
Credit 5.2	**Performance Measurement**, Enhanced Metering (8 specific actions)	1	OPTIONAL	
Credit 5.3	**Performance Measurement**, Enhanced Metering (12 specific actions)	1	OPTIONAL	
Credit 5.4	**Performance Measurement**, Emission Reduction Reporting	1	OPTIONAL	
Credit 6	**Documenting Sustainable Building Cost Impacts**	1	OPTIONAL	
Materials & Resources (MR)		Total **16** Points		
Prerequisite 1.1	**Source Reduction & Waste Management**, Waste Stream Audit	Required	OPTIONAL	
Prerequisite 1.2	**Source Reduction & Waste Management**, Storage & Collection	Required	OPTIONAL	

LEED-EB Version 2.0 Project Checklist[1]

Target LEED Project Points
Fort Hood, TX

Credit	Description	LEED Point(s)	Fort Hood Target Point[2]	Completed
Prerequisite 2	**Toxic Material Source Reduction**, Reduced Mercury in Light Bulbs	Required	OPTIONAL	
Credit 1.1	**Construction, Demolition & Renovation Waste Management**, Divert 50%	1	OPTIONAL	
Credit 1.2	**Construction, Demolition & Renovation Waste Management**, Divert 75%	1	OPTIONAL	
Credit 2.1	**Optimize Use of Alternative Materials**, 10% of Total Purchases	1	OPTIONAL	
Credit 2.2	**Optimize Use of Alternative Materials**, 20% of Total Purchases	1	OPTIONAL	
Credit 2.3	**Optimize Use of Alternative Materials**, 30% of Total Purchases	1	OPTIONAL	
Credit 2.4	**Optimize Use of Alternative Materials**, 40% of Total Purchases	1	OPTIONAL	
Credit 2.5	**Optimize Use of Alternative Materials**, 50% of Total Purchases	1	OPTIONAL	
Credit 3.1	**Optimize Use of IAQ Complaint Products**, 45% of Annual Purchases	1	OPTIONAL	
Credit 3.2	**Optimize Use of IAQ Complaint Products**, 90% of Annual Purchases	1	OPTIONAL	
Credit 4.1	**Sustainable Cleaning Products & Materials**, 30% of Total Purchases	1	OPTIONAL	
Credit 4.2	**Sustainable Cleaning Products & Materials**, 60% of Total Purchases	1	OPTIONAL	
Credit 4.3	**Sustainable Cleaning Products & Materials**, 90% of Total Purchases	1	OPTIONAL	
Credit 5.1	**Occupant Recycling**, Recycle 30% of Total Waste Stream	1	OPTIONAL	
Credit 5.2	**Occupant Recycling**, Recycle 40% of Total Waste Stream	1	OPTIONAL	
Credit 5.3	**Occupant Recycling**, Recycle 50% of Total Waste Stream	1	OPTIONAL	

LEED-EB Version 2.0 Project Checklist[1]

Target LEED Project Points
Fort Hood, TX

Credit	Description	LEED Point(s)	Fort Hood Target Point[2]	Completed
Credit 6	**Additional Toxic Material Source Reduction**, Reduced Mercury in Light Bulbs	1	OPTIONAL	
Indoor Environmental Quality (EQ)		Total **15** Points		
Prerequisite 1	**Outside Air Introduction & Exhaust Systems**	Required	OPTIONAL	
Prerequisite 2	**Environmental Tobacco Smoke (ETS) Control**	Required	OPTIONAL	
Prerequisite 3	**Asbestos Removal or Encapsulation**	Required	OPTIONAL	
Prerequisite 4	**PCB Removal**	Required	OPTIONAL	
Credit 1	**Outside Air Delivery Monitoring**	1	OPTIONAL	
Credit 2	**Increased Ventilation**	1	OPTIONAL	
Credit 3	**Construction IAQ Management Plan**	1	OPTIONAL	
Credit 4.1	**Documenting Productivity Impacts**, Absenteeism & Healthcare Cost Impacts	1	OPTIONAL	
Credit 4.2	**Documenting Productivity Impacts**, Other Productivity Impacts	1	OPTIONAL	
Credit 5.1	**Indoor Chemical & Pollutant Source Control**, Reduce Particulates in Air System	1	OPTIONAL	
Credit 5.2	**Indoor Chemical & Pollutant Source Control**, Isolation of High Volume Copying/Print Rooms/Fax Stations	1	OPTIONAL	
Credit 6.1	**Controllability of Systems**, Lighting	1	OPTIONAL	
Credit 6.2	**Controllability of Systems**, Temperatures & Ventilation	1	OPTIONAL	

LEED-EB Version 2.0 Project Checklist[1]

Target LEED Project Points
Fort Hood, TX

Credit	Description	LEED Point(s)	Fort Hood Target Point[2]	Completed
Credit 7.1	**Thermal Control**, Compliance	1	OPTIONAL	
Credit 7.2	**Thermal Control**, Permanent Monitoring System	1	OPTIONAL	
Credit 8.1	**Daylight & Views**, Daylight for 50% of Spaces	1	OPTIONAL	
Credit 8.2	**Daylight & Views**, Daylight for 75% of Spaces	1	OPTIONAL	
Credit 8.3	**Daylight & Views**, Views for 45% of Spaces	1	OPTIONAL	
Credit 8.4	**Daylight & Views**, Views for 90% of Spaces	1	OPTIONAL	
Credit 9	**Contemporary IAQ Practice**	1	OPTIONAL	
Credit 10.1	**Green Cleaning**, Entryway Systems	1	OPTIONAL	
Credit 10.2	**Green Cleaning**, Isolation of Janitorial Closets	1	OPTIONAL	
Credit 10.3	**Green Cleaning**, Low Environmental Impact Cleaning Policy	1	OPTIONAL	
Credit 10.4	**Green Cleaning**, Low Environmental Impact Pest Management Policy	1	OPTIONAL	
Credit 10.5	**Green Cleaning**, Low Environmental Impact Pest Management Policy	1	OPTIONAL	
Credit 10.6	**Green Cleaning**, Low Environmental Impact Cleaning Equipment Policy	1	OPTIONAL	
Innovation & Design Process (ID)		Total **5** Points		
Credit 1.1	**Innovation in Upgrades, Operation & Maintenance**	1	OPTIONAL	
Credit 1.2	**Innovation in Upgrades, Operation & Maintenance**	1	OPTIONAL	
Credit 1.3	**Innovation in Upgrades, Operation & Maintenance**	1	OPTIONAL	
Credit 1.4	**Innovation in Upgrades, Operation & Maintenance**	1	OPTIONAL	

LEED-EB Version 2.0 Project Checklist[1]

Target LEED Project Points
Fort Hood, TX

Credit	Description	LEED Point(s)	Fort Hood Target Point[2]	Completed
Credit 2	**LEED® Accredited Professional**	1	OPTIONAL	
Total Points				
	Total	**85**	**OPTIONAL**	

LEED-EB credits should be considered when conducting maintenance projects for existing buildings at Fort Hood.

LEED-EB Certification Levels:
- **Certified** 32-39 points
- **Silver** 40-47 points
- **Gold** 48-63 points
- **Platinum** 64-85 points

Notes:
[1] *Table created February 27, 2007; Reference LEED-EB Reference Guide Version 2.0.*
[2] *Those identified with:*
- ***YES*** *– will be required by Fort Hood.*
- ***NO*** *– will not be required by Fort Hood*
- ***OPTIONAL*** *– including credit is at the discretion of the project manager.*

For more information on LEED visit the U.S. Green Building Council website at www.usgbc.org or contact the Fort Hood LEED Coordinator, DPW – Environmental at (254) 287-6499 for more information.

D.3 LEED-HOMES CHECKLIST

LEED-Homes Version 1.11a Project Checklist[1]

Target LEED Project Points
Fort Hood, TX

Credit	Description	LEED Point(s)	Fort Hood Target Point[2]	Completed
Innovation and Design Process (ID)		Total **9** Points; Minimum of 0 Points Required		
Credit 1.1	**Integrated Project Planning**, Preliminary Rating	Prerequisite	YES	
Credit 1.2	**Integrated Project Planning**, Integrated Project Team	1	YES	
Credit 1.3	**Integrated Project Planning**, Design Charrette	1	YES	
Credit 2.1	**Quality Management for Durability**, Durability Planning (Pre-Construction)	Prerequisite	YES	
Credit 2.2	**Quality Management for Durability**, Wet Room Measures	Prerequisite	YES	
Credit 2.3	**Quality Management for Durability**, Quality Management	Prerequisite	YES	
Credit 2.4	**Quality Management for Durability**, Third-Party Durability Inspection	3	YES	
Credit 3.1	**Innovative/Regional Design**, Provide Description and Justification for Specific Measure	1	YES	
Credit 3.2	**Innovative/Regional Design**, Provide Description and Justification for Specific Measure	1	YES	
Credit 3.3	**Innovative/Regional Design**, Provide Description and Justification for Specific Measure	1	OPTIONAL	
Credit 3.4	**Innovative/Regional Design**, Provide Description and Justification for Specific Measure	1	OPTIONAL	
Location and Linkages (LL)[3]		Total **10** Points; Minimum of 0 Points Required		
Credit 2	**Site Selection**, Avoid Environmentally Sensitive Sites and Farmland	2	YES	
Credit 3.1	**Preferred Locations**, Select an Edge Development Site	1	YES	

LEED-Homes Version 1.11a Project Checklist[1]

Target LEED Project Points
Fort Hood, TX

Credit	Description	LEED Point(s)	Fort Hood Target Point[2]	Completed
Credit 3.2	***OR,*** **Preferred Locations**, Select an Infill Site	2	OPTIONAL	
Credit 3.3	**Preferred Locations**, Select a Previously Developed Site	1	OPTIONAL	
Credit 4	**Infrastructure**, Site within ½ mile of Existing Water and Sewer	1	YES	
Credit 5.1	**Community Resources & Public Transit**, Basic Community Resources/Public Transportation	1	OPTIONAL	
Credit 5.2	***OR,*** **Community Resources & Public Transit**, Extensive Community Resources/Public Transportation	2	OPTIONAL	
Credit 5.3	***OR,*** **Community Resources & Public Transit**, Outstanding Community Resources/Public Transportation	3	OPTIONAL	
Credit 6	**Access to Open Space**, Publicly Accessible Green Space	1	OPTIONAL	
Sustainable Sites (SS)		Total **21** Points; Minimum of 5 Points Required		
Credit 1.1	**Site Stewardship**, Erosion Controls (During Construction)	Prerequisite	YES	
Credit 1.2	**Site Stewardship**, Minimize Disturbed Area of Site	1	YES	
Credit 2.1	**Landscaping**, No Invasive Plants	Prerequisite	YES	
Credit 2.2	**Landscaping**, Basic Landscaping Design	2	YES	
Credit 2.3	**Landscaping**, Limit Turf	3	YES	
Credit 2.4	**Landscaping**, Drought Tolerant Plants	2	YES	
Credit 3	**Shading of Hardscapes**, Locate and Plant Trees to Shade Hardscapes	1	OPTIONAL	
Credit 4.1	**Surface Water Management**, Design Permeable Site	4	YES	

LEED-Homes Version 1.11a Project Checklist[1]

Target LEED Project Points
Fort Hood, TX

Credit	Description	LEED Point(s)	Fort Hood Target Point[2]	Completed
Credit 4.2	**Surface Water Management**, Design and Install Permanent Erosion Controls	2	OPTIONAL	
Credit 5	**Non-Toxic Pest Control**, Select Insect and Pest Control Alt's from List	2	YES	
Credit 6.1	**Compact Development**, Average Housing Density ≥ Units/Acre	2	YES	
Credit 6.2	***OR,* Compact Development**, Average Housing Density ≥ 10 Units/Acre	3	OPTIONAL	
Credit 6.3	***OR,* Compact Development**, Average Housing Density ≥ 20 Units/Acre	4	OPTIONAL	
Water Efficiency (WE)		Total **15** Points; Minimum of 3 Points Required		
Credit 1.1	**Water Reuse**, Rainwater Harvesting System	4	OPTIONAL	
Credit 1.2	**Water Reuse**, Grey Water Reuse System	1	OPTIONAL	
Credit 2.1	**Irrigation System**, Select High Efficiency Measures from List	3	YES	
Credit 2.2	**Irrigation System**, Third Party Verification	1	OPTIONAL	
Credit 2.3	***OR,* Irrigation System**, Install Landscape designed by Licensed or Certified Professional	4	OPTIONAL	
Credit 3.1	**Indoor Water Use**, High Efficiency Fixtures	3	YES	
Credit 3.2	***OR,* Indoor Water Use**, Very High Efficiency Fixtures	6	OPTIONAL	
Energy and Atmosphere (EA)		Total **38** Points; Minimum of 0 Points Required		
Credit 1.1	Meets ENERGY STAR for Homes with Third-Party Testing	Prerequisite	YES	
Credit 1.2*	Exceeds ENERGY STAR for Homes	34	YES	
Credit 7.1 (a)	**Water Heating**, Improved Hot Water Distribution System	2	YES	

LEED-Homes Version 1.11a Project Checklist[1]

Target LEED Project Points
Fort Hood, TX

Credit	Description	LEED Point(s)	Fort Hood Target Point[2]	Completed
Credit 7.2(a)	**Water Heating**, Pipe Insulation	1	YES	
Credit 11(a)	**Refrigerant Management**, Minimize Ozone Depletion and Global Warming Contributions	1	YES	
EA Alternate Path, if no to IEQ Credit 1.2 then use Credit 2.1(b) through 11(b) instead				
Credit 2.1(b)	**Insulation**, Third-Party Inspection of Insulation, at Least HERS Grade II	Prerequisite	OPTIONAL	
Credit 2.1(b)	**Insulation**, Third-Party Inspection of Insulation, Grade I AND 5% above code	2	OPTIONAL	
Credit 3.1(b)	**Air Infiltration**, Third-Party Envelope Air Leakage Tested </= 7.0 ACH50 (CZ 1-2)	Prerequisite	OPTIONAL	
Credit 3.2(b)	**Air Infiltration**, Third-Party Envelope Air Leakage Tested </= 7.0 ACH50 (CZ 1-2)	2	OPTIONAL	
Credit 3.3(b)	***OR,*** **Air Infiltration**, Third-Party Envelope Air Leakage Tested </= 7.0 ACH50 (CZ 1-2)	3	OPTIONAL	
Credit 4.1(b)	**Windows**, Meet ENERGY STAR for Windows (see Table)	Prerequisite	OPTIONAL	
Credit 4.2(b)	**Windows**, Meet ENERGY STAR for Windows (see Table)	2	OPTIONAL	
Credit 4.3(b)	**Windows**, Meet ENERGY STAR for Windows (see Table)	3	OPTIONAL	
Credit 5.1(b)	**Duct Tightness**, Third-Party Duct Leakage Tested </= 4.0 CFM25/100 SF to Outside	Prerequisite	OPTIONAL	
Credit 5.2(b)	**Duct Tightness**, Third-Party Duct Leakage Tested </= 4.0 CFM25/100 SF to Outside	2	OPTIONAL	
Credit 5.3(b)	***OR,*** **Duct Tightness**, Third-Party Duct Leakage Tested </= 4.0 CFM25/100 SF to Outside	3	OPTIONAL	
Credit 6.1(b)	**Space Heating and Cooling**, Meets ENERGY STAR for HVAC w/Manual J & Refrigerant Charge Test	Prerequisite	OPTIONAL	
Credit 6.2(b)	**Space Heating and Cooling**, HVAC is Better than ENERGY STAR	2	OPTIONAL	
Credit 6.3(b)	***OR,*** **Space Heating and Cooling**, HVAC Substantially Exceeds ENERGY STAR	4	OPTIONAL	

LEED-Homes Version 1.11a Project Checklist[1]

Target LEED Project Points
Fort Hood, TX

Credit	Description	LEED Point(s)	Fort Hood Target Point[2]	Completed
Credit 7.1(b)	**Water Heating**, Improved Hot Water Distribution System	2	OPTIONAL	
Credit 7.2(b)	**Water Heating**, Pipe Insulation	1	OPTIONAL	
Credit 7.3(b)	**Water Heating**, Improved Water Heating System	3	OPTIONAL	
Credit 8.1(b)	**Lighting,** Install at Least Three ENERGY STAR labeled Light Fixtures (or CFLS)	Prerequisite	OPTIONAL	
Credit 8.2(b)	**Lighting,** Energy Efficient Fixtures and Controls	2	OPTIONAL	
Credit 8.3(b)	***OR,* Lighting,** ENERGY STAR Advanced Lighting Package	3	OPTIONAL	
Credit 9.1(b)	**Appliances**, Select Appliances from List	2	OPTIONAL	
Credit 9.2(b)	**Appliances**, Very Efficient Clothes Washer (MEF > 1.8 AND WF < 5.5)	1	OPTIONAL	
Credit 10(b)	**Renewable Energy**, Renewable Electric Generation System (1 Point/5% Reduction)	10	OPTIONAL	
Credit 11(b)	**Refrigerant Management**, Minimize Ozone Depletion and Global Warming Contributions	1	OPTIONAL	
Materials & Resources (MR)		Total **14** Points; Minimum of 2 Points Required		
Credit 1.1	**Material Efficient Framing**, Overall Waste Factor for Framing Order Shall be No more than 10%	Prerequisite	YES	
Credit 1.2	**Material Efficient Framing**, Advanced Framing Techniques	3	OPTIONAL	
Credit 1.3	***OR,* Material Efficient Framing**, Structurally Insulated Panels	2	OPTIONAL	
Credit 2.1	**Environmentally Preferable Products**, Tropical Woods, if Used, Must be FSC	Prerequisite	YES	
Credit 2.2	**Environmentally Preferable Products**, Select Environmentally	8	YES	

LEED-Homes Version 1.11a Project Checklist[1]

Target LEED Project Points
Fort Hood, TX

Credit	Description	LEED Point(s)	Fort Hood Target Point[2]	Completed
	Preferable Products from List			
Credit 3.1	**Waste Management**, Document Overall Rate of Diversion	Prerequisite	YES	
Credit 3.2	**Waste Management**, Reduce Waste Sent to Landfill by 25% to 100%	3	YES	
Indoor Environmental Quality (IEQ)		Total **20** Points; Minimum of 6 Points Required		
Credit 1*	**ENERGY STAR with Indoor Air Package (IAP)**	11	YES	
IEQ Alternate Path, if no to IEQ Credit 1 then use Credit 2.1 through 10.4				
Credit 2.1	**Combustion Venting**, Space Heating & DHW Equip w/Closed/Power Exhaust	Prerequisite	OPTIONAL	
Credit 2.2	**Combustion Venting**, Install High Performance Fireplace	2	OPTIONAL	
Credit 3	**Moisture Control**, Analyze Moisture Loads AND Install Central System (if Needed)	1	OPTIONAL	
Credit 4.1	**Outdoor Air Ventilation**, Meets ASHRAE Std. 62.2	Prerequisite	OPTIONAL	
Credit 4.2	**Outdoor Air Ventilation**, Dedicated Outdoor Air System (w/Heat Recovery)	2	OPTIONAL	
Credit 4.3	**Outdoor Air Ventilation**, Third-Party testing of Outdoor Air Flow Rate into Home	1	OPTIONAL	
Credit 5.1	**Local Exhaust**, Meets ASHRAE Std. 62.2	Prerequisite	OPTIONAL	
Credit 5.2	**Local Exhaust**, Timer/Automatic Controls for Bathroom Exhaust Fan	1	OPTIONAL	
Credit 5.3	**Local Exhaust**, Third-Party testing of Exhaust Air Flow Rate Out of Home	1	OPTIONAL	

LEED-Homes Version 1.11a Project Checklist[1]

Target LEED Project Points
Fort Hood, TX

Credit	Description	LEED Point(s)	Fort Hood Target Point[2]	Completed
Credit 6.1	**Supply Air Distribution**, Meets ACCA Manual D	Prerequisite	OPTIONAL	
Credit 6.2	**Supply Air Distribution**, Third-Party Testing of Supply Air Flow into Each Room in Home	2	OPTIONAL	
Credit 7.1	**Supply Air Filtering**, ≥8 MERV Filters, w/Adequate System Sir Flow	Prerequisite	OPTIONAL	
Credit 7.2	***OR,*** **Supply Air Filtering**, ≥10 MERV Filters, w/Adequate System Sir Flow	1	OPTIONAL	
Credit 7.3	***OR,*** **Supply Air Filtering**, ≥13 MERV Filters, w/Adequate System Sir Flow	2	OPTIONAL	
Credit 8.1	**Contaminant Control**, Seal-Off Ducts During Construction	1	OPTIONAL	
Credit 8.2	**Contaminant Control**, Permanent Walk-off Mats OR Shoe Storage OR Central Vacuum	2	OPTIONAL	
Credit 8.3	**Contaminant Control**, Flush Home Continuously for 1 Week with Windows Open	1	OPTIONAL	
Credit 9.1	**Radon Protection**, Install Radon Resistant Construction if Home is in EPA Zone 1	Prerequisite	OPTIONAL	
Credit 9.2	**Radon Protection**, Install Radon Resistant Construction if Home is not in EPA Zone 1	1	OPTIONAL	
Credit 10.1	**Garage Pollutant Protection**, No Air Handling Equipment OR Return Ducts in Garage	Prerequisite	OPTIONAL	
Credit 10.2	**Garage Pollutant Protection**, Tightly Seal Shared Surfaces between Garage and Home	2	OPTIONAL	
Credit 10.3	**Garage Pollutant Protection**, Exhaust Fan in Garage	1	OPTIONAL	

LEED-Homes Version 1.11a Project Checklist[1]

Target LEED Project Points
Fort Hood, TX

Credit	Description	LEED Point(s)	Fort Hood Target Point[2]	Completed
Credit 10.4	***OR,*** **Garage Pollutant Protection**, Detached Garage or No Garage	3	OPTIONAL	
Awareness and Education (AE)		Total **3** Points; Minimum of 0 Points Required		
Credit 1.1	**Education for Homeowner and/or Tenants**, Basic Occupant's Manual and Walkthrough of LEED Home	Prerequisite	YES	
Credit 1.2	**Education for Homeowner and/or Tenants**, Comprehensive Occupant's manual and Multiple Walkthroughs/Training	1	OPTIONAL	
Credit 1.3	**Education for Homeowner and/or Tenants**, Public Awareness of LEED home	1	OPTIONAL	
Credit 2	**Education for Building Managers**, Basic Building Manager's Manual and Walkthrough of LEED Home	1	OPTIONAL	
Total Points				
	Total	**129**	**>60**	

While the USGBC has not yet finalized nor has the US Army adopted LEED-Homes, Fort Hood will use this system for rating all Army Family Housing new construction projects and homes built under the Residential Communities Initiative. A level of SILVER will be strived for.

LEED-Homes Certification Levels:
- **Certified** 45-59 points
- **Silver** 60-74 points
- **Gold** 75-89 points
- **Platinum** 90-128 points

Notes:
[1] *Table created February 27, 2007; Reference LEED-Homes(Pilot Rating System) Version 1.11a, January 2007.*
[2] *Those identified with:*
YES *– will be required by Fort Hood.*
NO *– will not be required by Fort Hood*
OPTIONAL *– including credit is at the discretion of the project manager.*

LEED-Homes Version 1.11a Project Checklist[1]

Target LEED Project Points
Fort Hood, TX

Credit	Description	LEED Point(s)	Fort Hood Target Point[2]	Completed

[3] *LL will have an alternate path upon completion of LEED-Neighborhood Development (ND).*

For more information on LEED visit the U.S. Green Building Council website at www.usgbc.org or contact the Fort Hood LEED Coordinator, DPW – Environmental at (254) 287-6499 for more information.

APPENDIX E

Exterior Materials

OVERVIEW

The architectural recommendations for each visual zone discussed below are provided with photographic examples taken from Fort Hood. These recommendations are designed to bring a greater sense of legibility, uniformity and order to Fort Hood's built environment. Following the recommendations are Exterior Material Charts that are to be used in conjunction with the architectural recommendations. These charts provide recommendations for material types, color for individual building design elements by Facility category Code (e.g., roofs, walls, fenestrations, etc.).

Color recommendations for all facilities within the following Visual Zones shall adhere to Pantone color charts and specifications found within Appendix F of the Installation Design Guide.

Photo 1

A. AIRFIELD VISUAL ZONE

The Airfield Visual Zone (see Figures E-1 and E-2) consists of Hood Army Airfield within the eastern end of the Main Cantonment, and Robert Gray Army Airfield in West Fort Hood (Refer to Photo 1). Hangars and administration buildings are functional and utilitarian in design. Large hangars are constructed of sheet metal with bands of windows and clerestories (Refer to Photo 2). Administrative buildings are also constructed of sheet metal. Older administrative buildings are constructed of concrete block unit masonry, painted.

Photo 2

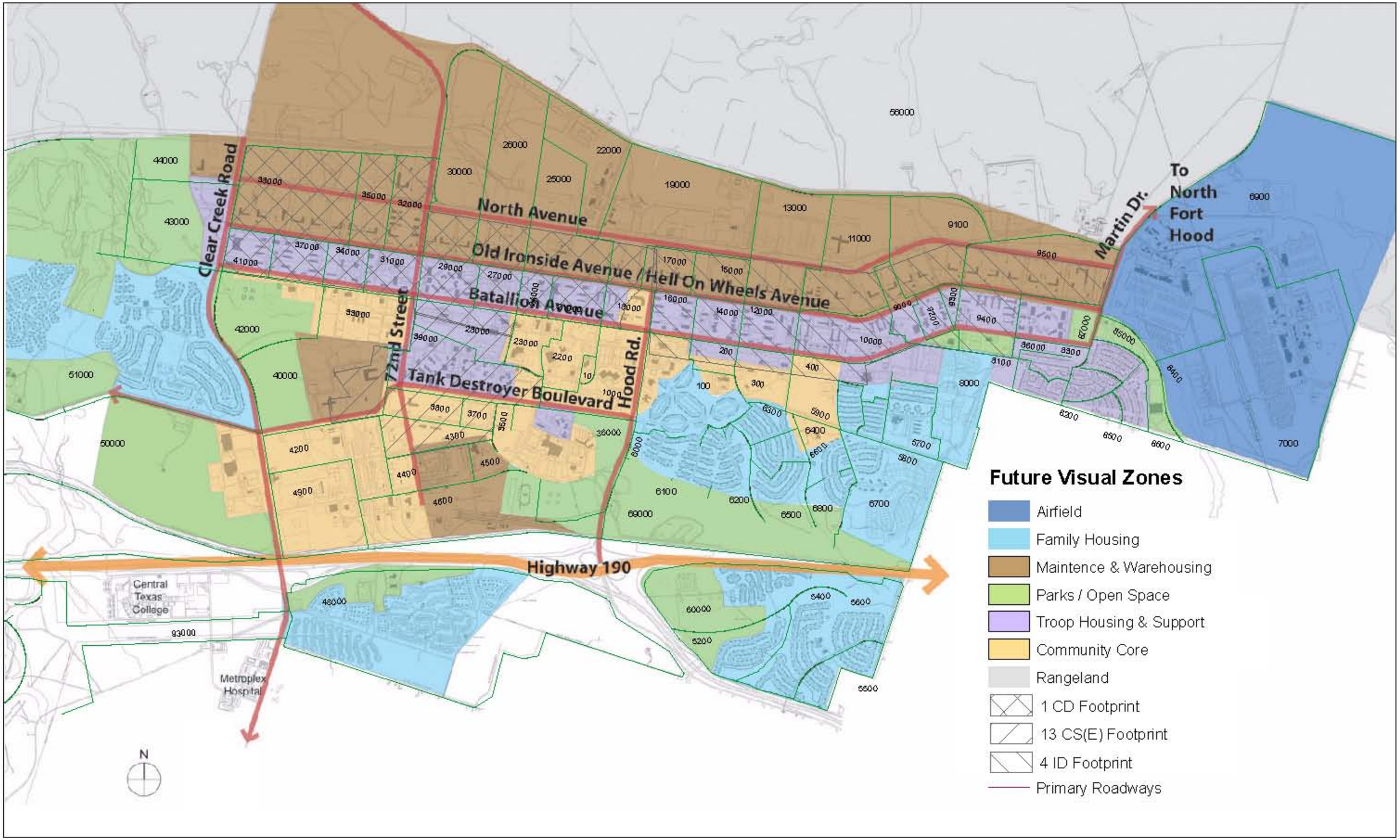

Figure E-1 Main Cantonment Future Visual Zones and Block Map

Figure E-2 West Fort Hood Future Visual Zone Map

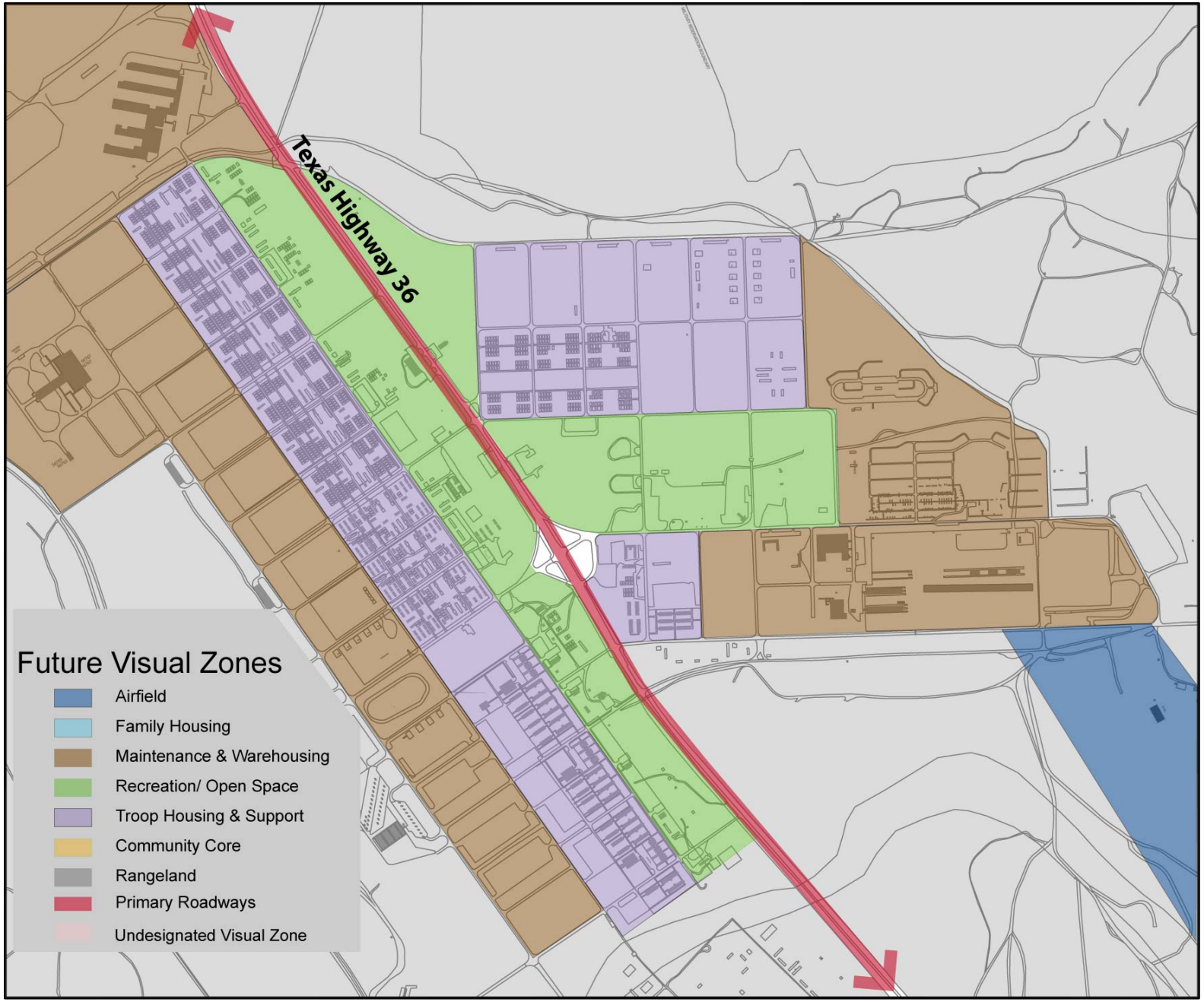

Figure E-3 North Fort Hood Future Visual Zone Map

Photo 3

Recommendations

Within both airfield visual zones, all new construction should emulate, in massing and in detail, the Flight Simulation / Motion Building, Number 7051 (Refer to Photo 3). Design of "big boxes" should be avoided. Where possible, building massing should be carefully articulated and distinct. Exterior facades should be brushed metal panels with rounded building corners. All trim and other detailing should be the same color and material as the predominant surface material. Entrances and windows should be recessed.

B. TROOP HOUSING AND SUPPORT VISUAL ZONE

The Troop Housing Visual Zone (see Figures E-1, E-2, and E-3) is principally composed of unaccompanied personnel housing (UPH), or troop barracks buildings (Catogory Code [CC]: 72111); administration buildings, including Brigade (CC: 14182), Battalion (CC: 14183), and Company (CC: 14185) headquarters and general purpose facilities (CC: 61050); and miscellaneous support buildings, including dining (CC: 72210) and physical fitness (CC: 74028) facilities. On the Main Cantonment, unit geographic organization is very important to defining unit integrity. Buildings are arranged from south to north based on land use. The southern-most building is the brigade headquarters building.

Recommendations

Siting of administrative buildings and unaccompanied personnel housing (UPH) buildings should aid in defining the edges of a campus-like setting, while maintaining overall unit integrity. Vehicular access to barracks and administrative buildings should be provided from secondary (collector) streets to minimize congestion associated with main arterial streets. Passenger loading/ drop-off should be designed near dormitory entrances.

1. Unaccompanied Personnel Housing (Troop Barracks)

Of the varying types of unaccompanied personnel housing (UPH) buildings at Fort Hood, the most predominant buildings are based on a 1+1 room configuration, 2+1 room configuration, and a 2+2 room configuration (typically termed Hammerheads, Rolling Pins, Stacks, EBs, H-Frames, and A-Frames). A-Frame barracks buildings have gang latrines and are no longer constructed. UPH buildings are located within the main Cantonment area, within the 1st Cavalry Division (1CD) footprint, the 4th Infantry Division (4ID) footprint,

and the 13th Sustainment Command (Expeditionary) (13SC[E]) (see Figure J-1). In West Fort Hood, UPH buildings are located within the 504 Military Intelligence Brigade (504MI BDE) footprint.

Photo 4

UPH Hammerhead and Rolling Pin-type barracks are long, narrow structures, typically three stories in height. Company and Battalion administrative headquarters are typically on the first floor and billeting is on the second and third floors. This density ensures an efficient use of available land while avoiding additional fire protection requirements, inconvenience to occupants, and structural and life-safety costs associated with buildings over three stories in height. Circulation consists of external, open-air galleries on all floors connecting individual units to central, internal staircases (Refer to Photo 4).

Photo 5

All UPH Hammerhead and Rolling Pin-type barracks buildings should be designed with an exterior masonry shell, composed of columns and solid balcony walls. Exterior brick masonry shells vary in color depending on location. Buildings should be designed so that all repetitive elements bear a symmetrical relationship to exterior shell columns and bays. The building's interior core shell should be either the same color and material as the exterior shell, or should be finished with a complementary, light-colored stucco. The main entrance to all floors is in the central part of the building. The exterior shell should be detailed with a small pediment or other embellishment to acknowledge the location of the primary entrance (Refer to Photo 5). For individual billets, the door and windows should be organized within a vertical surface that may or may not contrast the material and finish of the building core shell (Refer to Photo 6).

Photo 6

Photo 7

Stacks-type barracks are three-story buildings composed of either six or eight six-unit modules arranged in a staggered pattern and connected by shared, open-air staircases. Windows should be located in floor-to ceiling, recessed, vertical fields that are painted dark brown or a value of brown that complements the color of brick used (Refer to Photo 7). Horizontal banding, fascia and other embellishments should adhere to the height of floor levels. Ground-floor entrances should be in recessed alcoves. (Refer to Photo 8).

Photo 8

Photo 9

General

For all UPH barracks buildings, miscellaneous metal elements and accoutrements (grates, grills, louvers, wall / roof vents, fascia, railings, scuppers, downspouts, etc.) should be dark brown, unless specified otherwise. All Stacks buildings should be of medium to dark brown brick masonry. For Stacks buildings with open first floors, all ground-level surfaces should be painted white (Refer to Photo 9). Building roofs for all barracks buildings should be dark brown metal standing seam, unless noted otherwise.

1CD Footprint

Within the 1CD footprint (see Figure E-1)., three EB building complexes with a 1+1 room configuration are currently under construction within the 43000, 27000 and 42000 blocks. Rolling Pin buildings within the 41000, 37000 and 21000 blocks are a 2+1 configuration. Stacks buildings within the 29000 block are a 2+1 room configuration. A-Frame barracks buildings currently slated for demolition are located within the 41000, 34000, 31000 and 21000 blocks. For all barracks buildings within the 1CD footprint, the external shell should be beige brick and the internal core shell should be beige stucco (Refer to Photo 10).

Photo 10

Photo 11

4ID Footprint

Within the 4ID footprint (see Figure E-1) Rolling Pin buildings within the 16000 block and Stacks buildings within the 87000 block have a 2+1 room configuration. H-Frame buildings within the 14000 and 9200 blocks have a 1+1 room configuration. Rolling Pin and Hammerhead buildings within the 12000, 10000 and 9000 blocks have a 2+2 room configuration. For all barracks buildings within the 12000 block, between 37th Street and 31st Street, the external shell should be red brick and the internal core shell should be beige stucco (Refer to Photo 11). For all other barracks buildings within the 4ID footprint, the external shell should be dark brown and the internal core shell should be beige stucco (Refer to Photo 12).

Photo 12

13SC(E) Footprint

Facilities that are part of the 13 SC(E) (see Figure E-1) are located within the 40000 and 39000 blocks. This area is generally bounded by 58th Street to the east, 761st Tank battalion to the north, and undeveloped lands to the west. Within the 13SC(E) footprint, Stacks buildings within the 39000 block are a 1+1 room configuration. Stacks buildings should be of medium to dark brown brick masonry. For Stacks buildings with open first floors, all ground-level surfaces should be painted white (Refer to Photo 13). Building roofs for all barracks buildings should be dark brown metal standing seam, unless noted otherwise.

Photo 13

West Fort Hood

Within West Fort Hood, Rolling Pin buildings within the 91000 block are a 1+1 room configuration. For all barracks in West Fort Hood, the external shell should be dark brick and the internal core shell should be dark brown brick (Refer to Photo 14).

Photo 14

2. Administration Buildings

General

Brigade headquarters are typically prominent, figural, two-story buildings located in proximity to related administrative buildings, but not part of the campus organization. Brigade headquarters are located south of Battalion Avenue. Company and Battalion headquarters that are not housed within UPH Hammerhead or Rolling Pin-type barracks buildings are typically detached, single-story buildings located adjacent to barracks buildings, forming quads.

Recommendations

Headquarters buildings should be located orthogonally on the site, with facades parallel to primary and secondary roads. Internal rooms should be organized in a linear, repetitive arrangement with the primary entrance located in the center of the building (Refer to Photo 15). The primary entrance should open into a central hall / atrium. The atrium space should be the main organizing element for the building and should extend through the building as well as provide access to the lateral wings. Interior rooms should be organized on either side of a perpendicular hallway. The atrium should extend above the roof of the building and provide either skylights or clerestories to allow for natural light to penetrate the space. The main entrance should protrude beyond the main façade of the building (Refer to Photo 16). Windows and secondary entrances should be recessed within the building's facades (Refer to Photo 17). For all administrative buildings, miscellaneous metal elements and accoutrements (grates, grills, louvers, wall / roof vents, fascia, railings, scuppers, downspouts, etc.) should be dark brown, unless specified otherwise.

Photo 15

Photo 16

Photo 17

Administrative buildings should adhere to the color schemes of UPH barracks and other buildings found within particular division / brigade-level footprints. Within the1CD footprint, Battalion and Company buildings should be beige brick masonry (Refer to Photo 18). Within the 4ID footprint, Battalion and Company buildings should be medium to dark brown brick masonry (Refer to Photo 19). Within the13SC(E) footprint, Battalion and Company buildings should be medium to dark brown brick masonry (Refer to Photo 20). Within West Fort Hood, Battalion and Company buildings should be medium to dark brown brick masonry (Refer to Photo 21).

Photo 18

Photo 19

Photo 20

Photo 21

C. MAINTENANCE AND WAREHOUSING VISUAL ZONE

The Maintenance and Warehousing Visual Zone (see Figures E-1, E-2, and E-3) is composed of general purpose, utilitarian buildings associated with equipment maintenance and storage, located within motor pools. The Vehicle Maintenance Shop (CC: 21410) is the primary building in a motor pool. This building is oriented orthogonally in relation to the motor pool's perimeter fence and primary and secondary streets. The Vehicle Maintenance Shop is essentially a large, open warehouse / garage space with several vehicle bays and associated vertical rolling garage doors (Refer to Photo 22). Some Vehicle Maintenance Shops have designated office space, either built within or attached to the main building (Refer to Photo 23). The buildings are constructed of beige metal siding atop foundations of decorative concrete masonry, arranged in alternating bands of varying earth tones. Punctuating the beige siding are bands of opaque clerestories arranged in window patterns (Refer to Photo 24).

Photo 22

Photo 23

Photo 24

Other buildings include the Storage GP Inst building (CC: 44220) and the Dispatch building (CC: 14166).

Recommendations

Vehicle Maintenance Shops should be designed so that all external repetitive elements (lights, downspouts, vents, windows, clerestories, grills, signs, etc.) are equally spaced and arranged in order around the garage bay modules. Clerestories should be opaque and designed to look like windows. Masonry foundation walls should be constructed to match the height of garage doors. Roofs should be gently-pitched, and constructed of metal, with standing seams, and painted white (Refer to Photo 25).

Storage GP INST buildings should be constructed of decorative metal siding with gently-pitched metal roofs and standing seams, and painted white (Refer to Photo 26).

Dispatch buildings should be constructed of concrete masonry units and painted beige. Roofs should appear flat. Window and fascia trim to be painted dark brown (Refer to Photo 27).

Photo 25

Photo 26

Photo 27

D. COMMUNITY CORE VISUAL ZONE

The Community Core Visual Zone (see Figure E-1)is composed of facilities that support the entire installation, including military administrative services and commercial, educational and religious functions. Typically, buildings serve a single programmatic purpose / use. Unlike the Troop Housing Visual Zone, where individual buildings are oriented in a campus-like setting, forming internal quads, buildings that compose the Community Core Visual Zone are large and figural, and bear little relation to adjacent buildings. Large surface parking areas typically surround these buildings.

Recommendations

Although buildings are designed according to specific programmatic requirements, care should be taken to avoid designing big boxes. Carefully articulated massing is preferred, whereby a single building is composed of several distinct volumes (refer to Kieschnick Physical Fitness Center, Building 39008, Photo 28). The internal organization of the building should be readily apparent and legible from the exterior, beginning with a pronounced entrance. The most successful buildings within this visual zone are organized with wings around a central entrance – corridor axis (refer to Robertson Blood Center, Building 2250, Photo 29; and Fire Station, Building 23025, Photo 30). Buildings within this zone should be oriented orthogonally, with the principal facade facing toward the most heavily trafficked street.

Photo 28

Photo 29

Photo 30

The Community Core Visual Zone is divided into several distinct areas based on predominant building color. Within the western Cantonment, blocks 42000, 35000 and 39000, (see Figure E-1), buildings should be brown brick masonry, with a tan accent (approx. 20% of surface). Roofs should be gently sloped (4:12 pitch), red metal standing seam (Refer to Photo 31). From 62nd Street to Hood Road, within the 23000, 36000, 2200, 1000, and 10 blocks, buildings should be light beige masonry (Refer to Photo 32). East of Hood Road, within the 100, 200, 300, and 400 blocks, Community Core buildings should be light brown masonry and/or stucco (Refer to Photo 33).

Photo 31

Photo 32

Photo 33

E. RESIDENTIAL VISUAL ZONE

The Residential Visual Zone (see Figure E-1) consists of several neighborhoods of single- and multiple-family houses that vary in age and density. Of the most recent multi-family housing prototypes, three variations exist:

1. two-story unit with a shared central wall (Refer to Photo 34);

2. two-story unit and one story unit with opposing gables, separated by a front porch (Refer to Photo 35); and

3. two-story corner unit with primary facades oriented toward perpendicular streets (Refer to Photo 36).

Photo 34

Photo 35

Photo 36

There are variations with each of these prototypes. Garages are optional according to building program. Each prototype has one or more facade that is pronounced using some kind of embellishment, usually a change in building material. Facades are typically symmetrical and balanced. Some neighborhoods consist of all two-story units. Other neighborhoods combine all three prototypes.

Recommendations

With all residential housing prototypes, the building should be aligned orthogonally with the street layout. The primary entrance should be located on one of the unit's primary facades. For prototypes with both entrances on the same facade, the entrances should be bilaterally symmetrical around a central axis. Garages, typically two, should be attached to the outside walls of the unit (Refer to Photo 37). With one-story units, the garage should be integrated in to the main gable. Vertical surfaces should be stucco. Stucco color should be integral and based on hues identified within Appendix F: Exterior Color Charts. Primary facades should be limestone cobble. Roofs can be gabled

or hipped, and should maintain a 4:12 pitch and be constructed of light-colored asphalt shingles or metal standing seam. Porch roofs should be galvanized corrugated metal (Refer to Photo 38).

Photo 37

Photo 38

F Rangeland Visual Zone

Buildings within the Rangeland Visual Zone (see Figure E-1) are primarily used for administering and facilitating troop training activities. Buildings are utilitarian in appearance and are typically constructed of corrugated sheet metal. Storage buildings are long and narrow with a single gable. Troop training and field observation buildings are elevated, using open-frame, pier construction. The second floor enclosure is predominantly glass, surrounded by a full gallery, to view troop operations. Roofs are gently pitched to drain, as well as maintain a low profile.

Photo 39

Photo 40

Photo 41

Photo 42

EXTERIOR MATERIALS CHART

VISUAL ZONE: AIRFIELD		BUILDING TYPE: ADMINISTRATION		Category Code:	17210
Building Design Element		**Permitted Material Type / Application**	**Pantone Color**		**Notes**
GENERAL	**Stories**	1 to 2 stories			
	Massing of Building	Avoid big boxes; articulated massing of volumes			
	Signage (on building)	16" (w) x 12" (h) metal sign plate, located on front façade and top edge is flush with the door lintel	11-0604 TPX	white/ shell	
	Entry Treatment	Recessed entrance			
WALLS	**Primary Material**	Sheet metal panels	11-0604 TPX	shell, metal	see note 1
	Secondary Material (%)				
	Building Detail/ Embellishments	Façade of building have recessed portion dictated by length of ribbon window; this recession pronounces corners of building.			
ROOF	**Pitch**	Minimal pitch to appear flat			
	Material	Metal, standing seam, 16" O.C.	11-0604 TPX	white/ shell	
	Other	36" parapet roof			
FENESTRATION	**Entrance Doors**	Full glass pane double doors with window lite panels to each side			
	Door Frames and Detail	2" metal frame		metal	see note 1
	Secondary Entrance Doors	Metal, hollow core door		metal	see note 1
	Window Treatment	Ribbon windows, recessed; operable transom		tinted, green/ blue	
	Window Frame and Detail	2" metal frame		metal	see note 1
	Soffit	12" overhang, recessed lighting	11-0604 TPX	shell	
	Gutters and Downspouts	Rectangular 4x6 metal DS leader, located on exterior wall , equally spaced for length of façade.			
	Awnings and Canopies	36" overhang at entryway extending from façade			
	Miscellaneous Trim Elements and Metal Features (including Fascia, Fire Escape, Grills, Roof and Wall Ventilators, Louvers, Lighting Fixtures,	All trim elements are metal and uniform in color. Color will compliment or contrast the primary material.	15-5704 TPX	metal	see note 2

EXTERIOR MATERIALS CHART					
VISUAL ZONE: AIRFIELD		BUILDING TYPE: ADMINISTRATION		**Category Code:**	17210
Building Design Element		**Permitted Material Type / Application**	**Pantone Color**		**Notes**
	Switches, Plates)				
	Railing	Metal pipe railing		metal	see note 1
RELATED SITE ELEMENTS	**Standing wall, fences, courtyard enclosure walls**				

NOTES	
Note 1	Metal elements to be galvanized or powder coated to approximate metal color (15-5704 TPX gray).
Note 2	All miscellaneous metals and trim items need to match in color, coating and finish, unless otherwise specified.
Note 3	
Note 4	

EXTERIOR MATERIALS CHART

VISUAL ZONE: AIRFIELD		BUILDING TYPE: HANGER		Category Code:	21110
Building Design Element		**Permitted Material Type / Application**	**Pantone Color**		**Notes**
GENERAL	**Stories**	Program specific			
	Massing of Building				
	Signage (on building)	16" (w) x 12" (h) metal sign plate, located on front façade and top edge is flush with the entrance door lintel	11-0604 TPX	white/ shell	
	Entry Treatment	Recessed entrance			
WALLS	**Primary Material**	Sheet metal panels	15-5704 TPX	metal	see note 1
	Secondary Material (%)				
	Building Detail/ Embellish-ments				
ROOF	**Pitch**	Minimal pitch to appear flat			
	Material	Metal, standing seam, 16" O.C.	11-0604 TPX	white/ shell	
	Other	36" parapet roof			
FENESTRATION	**Entrance Doors**	Metal, hollow core door		metal	see note 1
	Door Frames and Detail	2" metal frame		metal	see note 1
	Secondary Entrance Doors	Metal, hollow core door		metal	see note 1
	Window Treatment	Ribbon windows, recessed		tinted, green/ blue	
	Window Frame and Detail	2" metal frame		metal	see note 1
TRIM ITEMS	**Soffit**		11-0604 TPX	white/ shell	
	Gutters and Downspouts	Rectangular 4x6 metal DS leader, located on exterior wall , spaced to divide the band windows	14-4506 TPX	dark/blue gray	see note 2
	Awnings and Canopies				
	Miscellaneous Trim Ele-ments and Metal Features (including Fascia, Fire Es-cape, Grills, Roof and Wall Ventilators, Louvers, Light-ing Fixtures, Switches, Plates)	All trim elements are metal and uniform is color. Color will compliment or contrast the primary material.	14-4506 TPX	dark/blue gray	see note 2

EXTERIOR MATERIALS CHART					
VISUAL ZONE: AIRFIELD		BUILDING TYPE: HANGER		**Category Code:**	21110
Building Design Element		**Permitted Material Type / Application**	**Pantone Color**		**Notes**
	Railing	Metal pipe railing		metal	see note 1
RELATED SITE ELEMENTS	**Standing wall, fences, court-yard enclosure walls**				

NOTES	
Note 1	Metal elements to be galvanized or powder coated to approximate metal color (15-5704 TPX gray).
Note 2	All miscellaneous metals and trim items need to match in color, coating and finish, unless otherwise specified.
Note 3	
Note 4	

EXTERIOR MATERIALS CHART

VISUAL ZONE: RANGE		BUILDING TYPE: GENERAL		Category Code:	17971; 17123
Building Design Element		**Permitted Material Type / Application**	**Pantone Color**		**Notes**
GENERAL	**Stories**	1			
	Massing of Building				
	Signage (on building)	16" (w) x 12" (h) metal sign plate, located on front façade and top edge is flush with the door lintel	11-0604 TPX	white/ shell	
	Entry Treatment	Entryway located to one of side of front façade, flush with façade, 12" overhang to cover entry			
WALLS	**Primary Material**	Metal, standing seam metal, 16" O.C.	13-1009 TPX	tan	
	Secondary Material (%)				
	Building Detail/ Embellishments		18-1027 TPX	dark brown	
ROOF	**Pitch**	Minimal pitch			
	Material	Metal, standing seam, 16" O.C.	11-0604 TPX	white/ shell	
	Other	8" metal fascia	18-1027 TPX	dark brown	
FENESTRATION	**Entrance Doors**	Metal, hollow core door	18-1027 TPX	dark brown	
	Door Frames and Detail	2" metal frame	18-1027 TPX	dark brown	
	Secondary Entrance Doors	Metal, hollow core door	18-1027 TPX	dark brown	
	Window Treatment	Single vertical hung sash			
	Window Frame and Detail	2" metal frame			
TRIM ITEMS	**Soffit**	Metal panel, 32"	18-1027 TPX	dark brown	see note 2
	Gutters and Downspouts	Rectangular 4x4 metal DS leader, located on exterior wall as needed	18-1027 TPX	dark brown	see note 2
	Awnings and Canopies	16" standing seam metal, 32" overhang	11-0604 TPX	white/ shell	
	Miscellaneous Trim Elements and Metal Features (including Fascia, Fire Escape, Grills, Roof and Wall Ventilators, Louvers, Lighting Fixtures, Switches, Plates)	All trim elements are metal and uniform in color. Color will match primary material.		metal	see note 3

EXTERIOR MATERIALS CHART					
VISUAL ZONE: RANGE		BUILDING TYPE: GENERAL		**Category Code:**	17971; 17123
Building Design Element		**Permitted Material Type / Application**	**Pantone Color**		**Notes**
	Railing	Metal pipe horizontal railing, metal stairs with open risers		metal	see note 1
RELATED SITE ELEMENTS	**Standing wall, fences, courtyard enclosure walls**				

NOTES	
Note 1	Metal elements to be galvanized or powder coated to approximate metal color.
Note 2	Secondary colors to match primary material color
Note 3	All miscellaneous metals and trim items need to match in color, coating and finish, unless otherwise specified.
Note 4	

EXTERIOR MATERIALS CHART

VISUAL ZONE: MAINTENANCE AND WAREHOUSE		BUILDING TYPE: VEHICLE MAINTENANCE SHOP		Category Code:	21410
Building Design Element		**Permitted Material Type / Application**	**Pantone Color**		**Notes**
GENERAL	**Stories**	2, open second level			
	Massing of Building	Open warehouse with vehicle bays			
	Signage (on building)	16" (w) x 12" (h) metal sign plate, located on front façade and top edge is flush with the door lintel	11-0604 TPX	white/ shell	
	Entry Treatment	Recessed entry under quarter of building with exaggerated overhang from the ridge of roofline			
WALLS	**Primary Material**	Metal siding	13-1013 TPX	allspice	
	Secondary Material (%)	Split faced masonry	13-1107 TPX	beige	
	Building Detail/ Embellishments	Smooth concrete masonry along roof and base of building and bands around windows	15-1306 TPX	taupe	
ROOF	**Pitch**	4:12 pitch			
	Material	Metal, standing seam, 16" O.C.	11-0604 TPX	white/ shell	
	Other	8" fascia along roof	18-1027 TPX	dark brown	
FENESTRATION	**Entrance Doors**	Full glass pane double doors		brown tint	
	Vehicular Door	Vertical pull garage bay door, slightly recessed, metal	18-1027 TPX	dark brown	
	Door Frames and Detail	2" metal frame	18-1027 TPX	dark brown	
	Secondary Entrance Doors	Metal, hollow core door with window opening	18-1027 TPX	dark brown	
	Window Treatment/ Clerestory	4-pane window, vertical hung sash; opaque 18-pane clere-story window; ribbon windows on second story, evenly spaced between garage bays		clear, white	
	Window Frame and Detail	2" metal frame	18-1027 TPX	dark brown	
TRIM ITEMS	**Soffit**				
	Gutters and Downspouts	Rectangular 4x6 metal DS leader, located on exterior wall along corner edges of building, two- toned, shoe of spout is lighter	18-1027 TPX	dark brown	
	Awnings and Canopies				

EXTERIOR MATERIALS CHART					
VISUAL ZONE: MAINTENANCE AND WAREHOUSE		BUILDING TYPE: VEHICLE MAINTENANCE SHOP		**Category Code:**	21410
Building Design Element		**Permitted Material Type / Application**	**Pantone Color**		**Notes**
	Miscellaneous Trim Elements and Metal Features (including Fascia, Fire Escape, Grills, Roof and Wall Ventilators, Louvers, Lighting Fixtures, Switches, Plates)	All trim elements are metal and uniform is color. Color will compliment or contrast the primary material.	18-1027 TPX	dark brown	see note 2
	Railing	Metal pipe horizontal railing		metal	see note 1
RELATED SITE ELEMENTS	**Standing wall, fences, courtyard enclosure walls**				

NOTES	
Note 1	Metal elements to be galvanized or powder coated to approximate metal color.
Note 2	All miscellaneous metals and trim items need to match in color, coating and finish, unless otherwise specified.
Note 3	
Note 4	

EXTERIOR MATERIALS CHART

VISUAL ZONE: MAINTENANCE AND WAREHOUSE		BUILDING TYPE: GENERAL PURPOSE STORAGE		Category Code:	44220
Building Design Element		**Permitted Material Type / Application**	**Pantone Color**		**Notes**
GENERAL	**Stories**	1			
	Massing of Building				
	Signage (on building)	16" (w) x 12" (h) metal sign plate, located on front façade and top edge is flush with the door lintel	11-0604 TPX	white/ shell	
	Entry Treatment	Slightly recessed metal garage bay entry; additional entry to side of façade.	19-1540 TPX	maroon	
WALLS	**Primary Material**	standing seam metal	13-1009 TPX	tan	
	Secondary Material (%)				
	Building Detail/ Embellishments		19-1540 TPX	maroon/ dark brown	
ROOF	**Pitch**	4:12 pitch			
	Material	Metal, standing seam, 16" O.C.	11-0604 TPX	white/ shell	
	Other	8' metal fascia	11-0604 TPX	white/ shell	
FENESTRATION	**Entrance Doors**	Metal, hollow core door	19-1540 TPX	maroon	
	Door Frames and Detail	4" metal frame			
	Secondary Entrance Doors	Metal, hollow core door	19-1540 TPX	maroon	
	Window Treatment				
	Window Frame and Detail		18-1027 TPX	dark brown	
TRIM ITEMS	**Soffit**				
	Gutters and Downspouts	rectangular 4x4 metal DS leader at corners along exterior wall of building	18-1027 TPX	dark brown	
	Awnings and Canopies				
	Miscellaneous Trim Elements and Metal Features (including Fascia, Fire Escape, Grills, Roof and Wall Ventilators, Louvers, Lighting Fixtures, Switches, Plates)	All trim elements are metal and uniform is color. Color will compliment or contrast the primary material.	18-1027 TPX	dark brown	see note 2

EXTERIOR MATERIALS CHART					
VISUAL ZONE: MAINTENANCE AND WAREHOUSE		BUILDING TYPE: GENERAL PURPOSE STORAGE		**Category Code:**	44220
Building Design Element		**Permitted Material Type / Application**	**Pantone Color**		**Notes**
	Railing				
RELATED SITE ELEMENTS	**Standing wall, fences, courtyard enclosure walls**				
	Dumpsters				

NOTES	
Note 1	Metal elements to be galvanized or powder coated to approximate metal color.
Note 2	All miscellaneous metals and trim items need to match in color, coating and finish, unless otherwise specified.
Note 3	
Note 4	

EXTERIOR MATERIALS CHART

VISUAL ZONE: COMMUNITY CORE	BUILDING TYPE: ADMINISTRATION		Category Code:	74028; 53020; 73010
Building Design Element	**Permitted Material Type / Application**	**Pantone Color**		**Notes**
GENERAL				
Stories	1 to 2 stories (program specific)			
Massing of Building	Avoid big boxes; articulated massing of volumes			
Signage (on building)	16" (w) x 12" (h) metal sign plate, located on front façade and top edge is flush with the door lintel	11-0604 TPX	white/ shell	
Entry Treatment	Protruding portico entry with pronounced central element(s) that creates corridor axis through entire building.			
WALLS				
Primary Material	Brick masonry		see note 3	
Secondary Material (%)	Stucco, split faced masonry		see note 3	
Building Detail/ Embellishments	Transition of varying materials or color of material along foundation, roof lines, or window lintels.		see note 3	
ROOF				
Pitch	4:12 pitch			
Material	Metal, standing seam, 16" O.C.	18-1027 TPX	dark brown	see note 5
Other	8" metal fascia; standing seam detail of roof can be carried over the fascia of the roof line			
FENESTRATION				
Entrance Doors	Full glass pane doors, double doors with window lite panels to each side, recessed			
Door Frames and Detail	2" metal frame	13-1009 TPX	tan	see note 2 & 4
Secondary Entrance Doors	Metal, hollow core door with 2" frame, recessed	13-1009 TPX	tan	see note 2 & 4
Window Treatment	recessed windows, consistent repetition throughout building			
Window Frame and Detail	2" metal frame	13-1009 TPX	tan	see note 2 & 4
Soffit				
Gutters and Downspouts	Rectangular 4x6 metal DS leader, evenly spaced along exterior wall of building	13-1009 TPX	tan	see note 2 & 4
Awnings and Canopies				
Miscellaneous Trim Elements and Metal Features (including Fascia, Fire Escape, Grills, Roof and Wall Ventilators, Louvers, Lighting Fixtures, Switches, Plates)	All trim elements are metal and uniform is color. Color will compliment or contrast the primary material.	13-1009 TPX	tan	see note 2 & 4

EXTERIOR MATERIALS CHART					
VISUAL ZONE: COMMUNITY CORE		BUILDING TYPE: ADMINISTRATION		**Category Code:**	74028; 53020; 73010
Building Design Element		**Permitted Material Type / Application**	**Pantone Color**		**Notes**
	Railing			metal	see note 1
RELATED SITE ELEMENTS	**Standing wall, fences, courtyard enclosure walls**				

NOTES

Note 1	Metal elements to be galvanized or powder coated to approximate metal color.
Note 2	All miscellaneous metals and trim items need to match in color, coating and finish, unless otherwise specified.
Note 3	Primary and secondary material color will vary in accordance with designated color zones. All buildings within the Western Cantonment blocks 42000,35000, and 39000 should be: 16-1221 TPX (brown) brick masonry; All buildings from 62nd Street to Hood Street (23000, 36000, 2200, 1000, and 10 blocks) should be: 13-1107 (light beige) masonry; All buildings east of Hood Road (100, 200, 300, and 400 blocks) should be: 15-1309 TPX (light brown/ natural) masonry and/ or stucco.
Note 4	accent color will vary with designated color zone. All buildings within the Western Cantonment blocks 42000,35000, and 39000 should have 13-1009 TPX (tan) accents; All buildings from 62nd Street to Hood Street (23000, 36000, 2200, 1000, and 10 blocks) should have 18-1027 TPX (dark brown) accents; All buildings east of Hood Road (100, 200, 300, and 400 blocks) should have 13-1009 TPX (tan) accents.
Note 5	roof color will vary with designated color zone All buildings within the Western Cantonment blocks 42000,35000, and 39000 should have 18-1444 TPX (red) roofs; All buildings from 62nd Street to Hood Street (23000, 36000, 2200, 1000, and 10 blocks) should have 18-1027 TPX (dark brown) roofs; All buildings east of Hood Road (100, 200, 300, and 400 blocks) should have 18-1027 TPX (dark brown) roofs.

EXTERIOR MATERIALS CHART

VISUAL ZONE: TROOP HOUSING & SUPPORT		BUILDING TYPE: UNACCOMPANIED PERSONNEL HOUSING (Rolling Pin)		Category Code:	72111
Building Design Element		**Permitted Material Type / Application**	**Pantone Color**		**Notes**
GENERAL	**Stories**	3			
	Massing of Building	Linear organization, multi-story with repetitive elements			
	Signage (on building)	16" (w) x 12" (h) sign masonry plate, located on all facades, 9' from floor level; sign should be integral with building	11-0604 TPX	white/ shell	
	Entry Treatment	Recessed entrance that leads into internal hallway cutting through the first floor of structure; brick pediment framing entryway with columns extending to roof.			
WALLS	**Primary Material**	Brick, the external shell of structure's exterior composition		see note 2	
	Secondary Material (%)	Stucco (45%), the internal shell of structure's exterior composition		see note 2	
	Building Detail/ Embellishments	Masonry, concrete, or solider course brick lintel			
ROOF	**Pitch**	4:12 pitch, hipped roof with flatten top			
	Material	Metal, standing seam, 16" O.C.	18-1027 TPX	dark brown	see note 3
	Other	Standing seam detail of roof is carried over the fascia of the roof line			
FENESTRATION	**Entrance Doors**	Metal, hollow core door (per unit), located on end of each unit's entry wall; repetitive door and window lite grouping along exterior corridor, entire door /window group is recessed into wall (interior shell) approximately 6".	18-1027 TPX	dark brown	
	Door Frames and Detail	2" metal frame	18-1027 TPX	dark brown	
	Secondary Entrance Doors	Metal, hollow core door	18-1027 TPX	dark brown	
	Window Treatment	Horizontal sliding window aligns with door lintel, recessed		tinted	
	Window Frame and Detail	2" metal frame; metal panels from base of widow sill to floor level	18-1027 TPX	dark brown	
TRIM ITEMS	**Soffit**	60" overhang, mounted lighting unit	13-1107 TPX	beige	
	Gutters and Downspouts	Rectangular 4x6 metal, located on exterior brick columns	18-1027 TPX	dark brown	
	Awnings and Canopies				
	Miscellaneous Trim Elements and Metal Features (including Fascia, Fire Escape, Grills, Roof and Wall Ventilators, Lou-	All trim elements are metal and uniform is color. Color will compli-ment or contrast the primary material.	18-1027 TPX	dark brown	see note 1

EXTERIOR MATERIALS CHART					
VISUAL ZONE: TROOP HOUSING & SUPPORT		BUILDING TYPE: UNACCOMPANIED PERSONNEL HOUSING (Rolling Pin)		**Category Code:**	72111
Building Design Element		**Permitted Material Type / Application**	**Pantone Color**		**Notes**
	vers, Lighting Fixtures, Switches, Plates)				
	Railing	Rectangular, vertical railing with 8" spacing; half railing/ half brick wall on second and third levels		metal	see note 4
RELATED SITE ELEMENTS	**Standing wall, fences, courtyard enclo-sure walls**				

NOTES	
Note 1	All miscellaneous metals and trim items need to match in color, coating and finish, unless otherwise specified.
Note 2	Primary and secondary material color will vary in accordance with designated building color zones. All barracks buildings within the 1st Calvary Division should be: 12-0910 TPX (custard) for the exterior brick and stucco; All barracks buildings within the 4th Infantry Division's 12000 block (37th Street through 31st Street) should be: 18-1444 TPX (red) brick and 13-1009 TPX (tan); All other barracks buildings within the 4th Infantry Division should be: should be: 18-1027 TPX (dark brown) brick and 12-0910 TPX (custard) stucco; All barracks buildings within West Fort Hood should be: 1116-1210 TPX (medium brown) to 18-1027 TPX (dark brown) brick.
Note 3	Roof material and pitch varies among barrack style (3 styles)
Note 4	Metal elements to be galvanized or powder coated to approximate metal color.

EXTERIOR MATERIALS CHART

VISUAL ZONE: TROOP HOUSING & SUPPORT	BUILDING TYPE: UNACCOMPANIED PERSONNEL HOUSING (Stacked)		Category Code:	72111
Building Design Element	**Permitted Material Type / Application**	**Pantone Color**		**Notes**
GENERAL				
Stories	3			
Massing of Building	Stacked modular buildings			
Signage (on building)	16" (w) x 12" (h) sign masonry plate, located on all facades, 9' from floor level; sign should be integral with building	11-0604 TPX	white/ shell	
Entry Treatment	Recessed entrance opening that leads into internal hallway. Exterior stairwell on each end of hallway. Stairwell divided quadrants into two sides of housing units.			
WALLS				
Primary Material	Brick	15-1306 TPX	taupe	
Secondary Material (%)	Concrete (15%)	18-1027 TPX	dark brown	
Building Detail/ Embellishments	Concrete striping divides building stories, detail will contrast the primary material color.	18-1027 TPX	dark brown	
ROOF				
Pitch	Minimal pitch to appear flat			
Material	Concrete			
Other	36" parapet roof	18-1027 TPX	dark brown	
FENESTRATION				
Entrance Doors	Metal, hollow core door (per unit), located on end of each unit's entry wall	18-1027 TPX	dark brown	
Door Frames and Detail	2" metal frame	18-1027 TPX	dark brown	
Secondary Entrance Doors	Metal, hollow core door	18-1027 TPX	dark brown	
Window Treatment	Rectangular panes, single vertical hung sash	18-1027 TPX	tinted, brown	
Window Frame and Detail	2" metal frame; metal panels from base of widow sill to floor level	18-1027 TPX	dark brown	
TRIM ITEMS				
Soffit				
Gutters and Downspouts				
Awnings and Canopies				
Miscellaneous Trim Elements and Metal Features (including Fascia, Fire Escape, Grills, Roof and Wall Ventilators, Louvers, Lighting Fixtures, Switches, Plates)	All trim elements are metal and uniform is color. Color will compliment or contrast the primary material.	18-1027 TPX	dark brown	see note 1
Railing	Rectangular, vertical railing with 8' spacing; railing along stairwell	18-1027 TPX	dark brown	see note 1

EXTERIOR MATERIALS CHART					
VISUAL ZONE: TROOP HOUSING & SUPPORT		BUILDING TYPE: UNACCOMPANIED PERSONNEL HOUSING (Stacked)		**Category Code:**	72111
Building Design Element		**Permitted Material Type / Application**	**Pantone Color**		**Notes**
RELATED SITE ELEMENTS	**Standing wall, fences, courtyard enclosure walls**				
NOTES					
Note 1	All miscellaneous metals and trim items need to match in color, coating and finish, unless otherwise specified.				
Note 2					
Note 3					
Note 4					

EXTERIOR MATERIALS CHART

VISUAL ZONE: TROOP HOUSING & SUPPORT		BUILDING TYPE: DINING FACILITY		Category Code:	72210; 74028
Building Design Element		**Permitted Material Type / Application**	**Pantone Color**		**Notes**
GENERAL	**Stories**	1			
	Massing of Building	Consistency in location of building elements to establish modular rhythm to structure			
	Signage (on building)	16" (w) x 12" (h) sign masonry plate, located on all facades, 9' from floor level; sign should be integral with building	11-0604 TPX	white/ shell	
	Entry Treatment	Pronounced entry portico with glass block panel and pitched pediment façade			
WALLS	**Primary Material**	Brick	15-1306 TPX	taupe	see note 2
	Secondary Material (%)	Stucco (25%)	13-1009 TPX	tan	see note 2
	Building Detail/ Embellishments	Split faced masonry (15%) along base of building, pediment façade of entryway is repeated throughout building	11-0907 TPX	almond	see note 2
ROOF	**Pitch**	4:12 pitch	18-1027 TPX	dark brown	
	Material	Metal, standing seam, 16" O.C.	18-1027 TPX	dark brown	
	Other	36" parapet			
FENESTRATION	**Entrance Doors**	Full glass pane double doors, recessed		tinted, brown	
	Door Frames and Detail	2" metal frame	18-1027 TPX	dark brown	
	Secondary Entrance Doors	Metal, hollow core door with 2" frame	18-1027 TPX	dark brown	
	Window Treatment	Recessed windows, consistent repetition throughout building, detailed lentil and sill to match building's detailing.		tinted, brown	
	Window Frame and Detail	2" metal frame	18-1027 TPX	dark brown	
TRIM ITEMS	**Soffit**				
	Gutters and Downspouts	Rectangular 4x6 metal DS leader, evenly spaced along exterior wall of building	18-1027 TPX	dark brown	see note 1
	Awnings and Canopies				
	Miscellaneous Trim Elements and Metal Features (including Fascia, Fire Escape, Grills, Roof and Wall Ventilators, Louvers, Lighting Fixtures, Switches, Plates)	All trim elements are metal and uniform is color. Color will compliment or contrast the primary material.	18-1027 TPX	dark brown	see note 1

EXTERIOR MATERIALS CHART					
VISUAL ZONE: TROOP HOUSING & SUPPORT		BUILDING TYPE: DINING FACILITY		**Category Code:**	72210; 74028
Building Design Element		**Permitted Material Type / Application**	**Pantone Color**		**Notes**
	Railing				
RELATED SITE ELEMENTS	**Standing wall, fences, courtyard enclosure walls**	Material and composition of element replicates the composition of the adjacent primary building.		see note 2	

NOTES	
Note 1	All miscellaneous metals and trim items need to match in color, coating and finish, unless otherwise specified.
Note 2	Primary and secondary material color should respond to adjacent buildings color scheme.
Note 3	
Note 4	

EXTERIOR MATERIALS CHART

VISUAL ZONE: TROOP HOUSING & SUPPORT		BUILDING TYPE: ADMINISTRATION		Category Code:	14182, 14183, 14185, 61050
Building Design Element		**Permitted Material Type / Application**	**Pantone Color**		**Notes**
GENERAL	**Stories**	1			
	Massing of Building	Linear organization with main entrance hallway and interior rooms perpendicular to entrance line. Exterior has repetitive arrangement of building elements.			
	Signage (on building)	16" (w) x 12" (h) sign masonry plate, located on all facades, 9' from floor level; sign should be integral with building	11-0604 TPX	white/ shell	
	Entry Treatment	Protruding entryway centrally located on the primary building façade. Central hallway opens to atrium. Atrium skylights extended beyond roof line.			
WALLS	**Primary Material**	brick		see note 2	
	Secondary Material (%)	masonry, concrete (40%)		see note 2	
	Building Detail/ Embellishments	solider course brick detail		see note 2	
ROOF	**Pitch**	minimal slope to appear flat			
	Material	Metal, standing seam, 16" O.C.	18-1027 TPX	dark brown	
	Other	8" metal fascia			
FENESTRATION	**Entrance Doors**	Full glass pane doors, double doors, recessed		tinted, brown	
	Door Frames and Detail	2" metal frame	18-1027 TPX	dark brown	
	Secondary Entrance Doors	Metal, hollow core door with 2" frame, recessed	18-1027 TPX	dark brown	
	Window Treatment	recessed windows, consistent repetition throughout building		tinted, brown	
	Window Frame and Detail	2" metal frame	18-1027 TPX	dark brown	
TRIM ITEMS	**Soffit**				
	Gutters and Downspouts	Rectangular 4x6 metal DS leader, evenly spaced along exterior wall of building	18-1027 TPX	dark brown	see note 1
	Awnings and Canopies				
	Miscellaneous Trim Elements and Metal Features (including Fascia, Fire Escape, Grills, Roof and Wall Ventilators, Lou-	All trim elements are metal and uniform is color. Color will compliment or contrast the primary material.	18-1027 TPX	dark brown	see note 1

EXTERIOR MATERIALS CHART

VISUAL ZONE: TROOP HOUSING & SUPPORT	BUILDING TYPE: ADMINISTRATION		Category Code:	14182, 14183, 14185, 61050
Building Design Element	**Permitted Material Type / Application**	**Pantone Color**		**Notes**
	vers, Lighting Fixtures, Switches, Plates)			
	Railing			
RELATED SITE ELEMENTS	**Standing wall, fences, courtyard enclo-sure walls**	Material and composition of element replicates the composition of the adjacent primary building.	see note 2	

NOTES

Note 1	All miscellaneous metals and trim items need to match in color, coating and finish, unless otherwise specified.
Note 2	Primary and secondary material color will vary in accordance with designated building color zones. All buildings within the 1st Calvary Division should be: 12-0910 TPX (custard) brick masonry; All buildings within the 4th Infantry Division should be: 116-1210 TPX (medium brown) to 18-1027 TPX (dark brown) brick masonry; All buildings within the Sustainment Command (Expeditionary) Division should be: should be: 1116-1210 TPX (medium brown) to 18-1027 TPX (dark brown) brick masonry; All barracks buildings within West Fort Hood should be: 1116-1210 TPX (medium brown) to 18-1027 TPX (dark brown) brick masonry.
Note 3	
Note 4	

EXTERIOR MATERIALS CHART

VISUAL ZONE: FAMILY HOUSING		BUILDING TYPE: RESIDENTIAL DUPLEX		Category Code:	
Building Design Element		**Permitted Material Type / Application**	**Pantone Color**		**Notes**
GENERAL	**Stories**	2 stories, 1 story garage			
	Massing of Building	Duplex			see note 1
	Signage (on building)	4' plate with address number, front façade of house, 10-12" below top of window lintel	11-0604 TPX	white/ shell	
	Entry Treatment	Pronounced limestone façade (pediment varies); concrete slab entry floor, two double post supporting canopy protruding 4' from facade, slightly recessed doorway			see note 2
WALLS	**Primary Material**	Two-toned stucco		see note 5	
	Secondary Material (%)	Limestone (primary façade only, ground level to beyond roof line)		natural	
	Building Detail/ Embellishments	Building divided by predominate and subordinate colored stucco with trim element between color layers			
ROOF	**Pitch**	4:12 pitch, gable roof or hipped roof			
	Material	Asphalt shingles		black	
FENESTRATION	**Entrance Doors**	Decorative metal door, slightly recessed into limestone with vertical window lite; variation in entrance orientation- both entrances parallel on same facade or separated on perpendicular facades	19-1540 TPX	maroon	
	Door Frames and Detail	2" metal frame, limestone lintel	19-1540 TPX	maroon	
	Secondary Entrance Doors	Metal, hollow core door	19-1540 TPX	maroon	
	Window Treatment	2-pane or 4-pane square windows. Windows within primary limestone façade are slightly recessed; windows within stucco are flush. 2-pane windows have horizontal sliding sash, 4-pane have vertical hung sash.		clear, no tint	
	Window Frame and Detail	2" metal frame; 4" wood trim surrounding windows	13-1107 TPX	beige	
TRIM ITEMS	**Fascia**	8" metal	13-1107 TPX	beige	
	Soffit	12" eave overhang	13-1107 TPX	beige	
	Gutters and Downspouts	4x4 metal DS leader, evenly spaced along exterior wall of building	13-1107 TPX	beige	see note 3
	Awnings and Canopies	Corrugated metal canopy over each entrance door		metal	see note 4
	Stair and Balcony Railing	Metal pipe railing, unpainted		metal	see note 4

EXTERIOR MATERIALS CHART					
VISUAL ZONE: FAMILY HOUSING		BUILDING TYPE: RESIDENTIAL DUPLEX		**Category Code:**	
Building Design Element		**Permitted Material Type / Application**	**Pantone Color**		**Notes**
	Handrails	Metal horizontal pipe railing, unpainted		metal	see note 4
	Grills, ventilators and Louvers	Metal, unpainted		metal	see note 4
RELATED SITE ELEMENTS	**Standing wall, fences, court-yard enclosure walls**	Garage is recessed under roof of main structure			

NOTES	
Note 1	Housing prototype variations: (1) two-story unit with shared central wall; (2) two-story unit and one-story unit with opposing gables, separated by a front porch; (3) two-story corner unit with primary façades oriented towards perpendicular streets.
Note 2	Variation #3- limestone façade on either side of central portico, concrete slab entry floor, three double post supporting canopy protruding 8' from façade
Note 3	All miscellaneous metals and trim items need to match in color, coating and finish, unless otherwise specified.
Note 4	Metal elements to be galvanized or powder coated to approximate metal color.
Note 5	Stucco color may vary among the follow colors: 16-6216 TPX (meal green), 12-0910 TPX (custard), 13-1009 TPX (tan), 15-1309 TPX (natural), 11-0907 TPX (almond), 13-1107 TPX (beige), and 16-1221 TPX (brown).

APPENDIX F

Exterior Color Chart

F.1 EXTERIOR COLOR CHARTS for INSTALLATION BUILDINGS

Colors schemes and building materials are critical design elements in relating adjacent buildings and creating a compatible visual environment within an installation. This section identifies the Army standard palette of colors that will unify installations. A sufficient color palette range is provided to allow for variety. General direction on the use and application of materials and their colors follows:

- Avoid cluttered, cosmetic application of a number of different colors on a facade. The exterior color scheme should consist of a wall color, trim color, and an accent color, all of which should work together with the choice of roofing to provide a harmonious appearance compatible with adjacent structures and environs.
- Select colors from the following Exterior Color Chart based upon their appropriateness to the building type, desired appearance, material to be painted, and prevailing architectural design and landscape character of the installation. Sustainability and ease of maintenance should also be considered.
- Avoid garish colors. Strong or vibrant colors should be used with restraint and should be limited to accents or focal points such as entrance doors where appropriate.

F.2 PANTONE® COLORS

The six-digit color designations found in the Exterior Color Charts are numbers taken from the PANTONE **for architecture and interiors color guide**, which have been cross-referenced to the PANTONE **process guide coated**. The colors in the PANTONE **process guide coated** are intended for viewing on a color monitor and for printing on a four-color process printer (CMYK) using ISO 2846-1 inks. With proper calibration, colors viewed and printed should accurately represent the specified color.

- Calibration for Dell FP E171 and 1800FP Monitor is per manufacturer's recommendation.
- Calibration for Hewlett Packard Color 4500 is per manufacturer's recommendation.
- For calibration of equipment other than the above, contact Pantone, Inc. at (201) 935-5500.

F.3 COLOR VALIDATION

F.3.1 Due to calibration and other technical problems, the color of paint to be used should be based on manufacturer's correspondence to the six-digit PANTONE Number and shall not be predicated on matching a computer-generated sample as seen in the Exterior Color Charts.

F.3.2 "White" when given without a number shall be construed as generic and is intended to cover those manufacturer's paints and finished materials called "white". Some slight variance may be discernible from one manufacturer to another.

F.4 COLOR NAMES

Names given for colors are not those assigned by Pantone, Inc., but are the generic names used by the Army for general color identification only. Always use the six-digit PANTONE **for architecture and interiors color guide** number instead of the generic name when specifying a color.

F.5 SUPPLEMENTAL COLOR BOARD

F.5.1 Included in this Appendix is a Color Board (Page F-4) containing squares with a simulation of each color used in the Exterior Color Charts. The electronic reproduction of this Color Board is, however, subject to some distortion and the color will be inaccurate to a greater or lesser degree depending on the printer used, and must, therefore, not be used in an attempt to accurately match or select paint samples.

F.5.2 A hard copy is available which contains accurate representations of all of the Army's standard exterior colors. The hard copy version of the color board may be requested by E-mail at:

Baxter.Lawrence@mantech.com with a copy to Dannie.Fason@mantech.com

If the E-mail is not acknowledged within three business days, call (703) 378-1030 to verify the request. Provide the following information: quantity of color boards requested; name, title, and telephone number of person placing the order; mailing address; and the name of the installation.

F.6 FACTORY FINISHED MATERIALS

Colors given for surfaces that will be factory finished during manufacturing are intended for guidance and are not intended to constitute a directive for a custom color or finish. Colors shall be selected from standard manufacturer colors with the exception of those products, which can be finished with a custom color at no additional cost or that would not result in diminishment of the standard material guarantee or serviceability.

F.7 SPECIALTY FINISHES

Site Elements, addressed in Chapter 11, are painted one of the colors used in the Color Charts and shown on the Color Board. Fire Hydrants (see Section 11.6.5 of the IDG) which shall be Nutmeg Brown in color shall be finished in a standard manufacturers paint, suitable for this application, to which glass beads or other suitable reflective material has been added so as to create a light reflective finish meeting NFPA standards.

F.8 WATER STORAGE TANK FINISHES

Water storage tank finishes shall be in accordance with Section 11.6.5 of the IDG.

Color Board from the Army Installation Design Standards / Appendix L

The color squares shown here are approximations of the PANTONE® **for architecture and interiors color** numbers indicated. They have been simulated using RGB values and are intended to be reproduced electronically. Color quality may vary with printer. PANTONE colors are a standard. In order to accurately reproduce the specified colors on these sheets and meet the required US Army standard, you must use the actual PANTONE swatch of the color indicated. A hard copy supplemental sheet with accurate color representations is available. See Paragraph F.5 for details.

PANTONE
11-0604 TPX
SHELL

PANTONE
11-0907 TPX
ALMOND

PANTONE
12-0910 TPX
CUSTARD

PANTONE
12-4607 TPX
PASTEL SKY

PANTONE
13-1009 TPX
TAN

PANTONE
13-1013 TPX
ALLSPICE

PANTONE
13-1107 TPX
BEIGE

PANTONE
14-4506 TPX
BLUEGRAY

PANTONE
15-1306 TPX
TAUPE

PANTONE
15-1309 TPX
NATURAL

PANTONE
15-5704 TPX
GRAY

PANTONE
16-1210 TPX
MOCHA

PANTONE
16-1221 TPX
BROWN

PANTONE
16-6216 TPX
METAL GREEN

PANTONE
18-1027 TPX
DARK BROWN

PANTONE
18-1444 TPX
SALSA

PANTONE
19-1540 TPX
MAROON

PANTONE
14-4318 TPX
SKY BLUE

PANTONE
18-1222 TPX
NUTMEG BROWN

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LISTING OF ORIGINAL SOURCE FEDERAL OR COMMERCIAL MANUFACTURER'S DESIGNATION WITH NEW IDS NAME & ACCEPTABLE PANTONE® DESIGNATIONS						
Source	**Old Federal Color Name and/or Number**	**Other Name and/or Number**	**IDS Name (Generic)**	PANTONE **Color Number**	**Process Number**	**(C-M-Y-K)**
Federal Paint Number	Tan 23578		TAN	PANTONE 13-1009 TPX	24-7 C	0-10-25-10
Federal Paint Number	Tan 23717		CUSTARD	PANTONE 12-0910 TPX	22-8 C	0-5-15-0
Federal Paint Number	Gray 26492		GRAY	PANTONE 15-5704 TPX	329-9 C	0-0-3-30
Federal Paint Number	White 20372		TAUPE	PANTONE 15-1306 TPX	31-8 C	5-10-20-20
Federal Paint Number	Metal Green 24373		METAL GREEN	PANTONE 16-6216 TPX	285-7 C	25-0-30-25
Federal Paint Number	Brown 20313		BROWN	PANTONE 16-1221 TPX	76-8 C	0-25-25-20
Federal Paint Number	Mocha 20372		MOCHA	PANTONE 16-1210 TPX	48-9 C	10-15-25-15
Federal Paint Number	Gray 25526		BLUEGRAY	PANTONE 14-4506 TPX	213-9 C	20-03-03-15
Federal Paint Number	Ochre 31643		ALLSPICE	PANTONE 13-1013 TPX	36-8 C	0-15-25-0
Duron	Oyster White 921	(Oyster White) Almond 5910W	ALMOND	PANTONE 11-0907 TPX	32-9 C	0-5-10-0
Duron	Alcazar Brown 8306N	Dark Brown 5225N	DARK BROWN	PANTONE 18-1027 TPX	318-1 C	70-80-100-30
Duron	Shell White 917	White 5770W	SHELL	PANTONE 11-0604 TPX	No Match	0-3-3-0
Generic (no mfg. ref.)	Chocolate		DARK BROWN	PANTONE 18-1027 TPX	318-1 C	70-80-100-30
ICI	Dusty Trail # 425		NATURAL	PANTONE 15-1309 TPX	44-7 C	20-20-30-5
ICI	Sand Motif # 422		MOCHA	PANTONE 16-1210 TPX	48-9 C	10-15-25-15
ICI	Bisque # 436		BEIGE	PANTONE 13-1107 TPX	43-9 C	10-10-15-0

LISTING OF ORIGINAL SOURCE FEDERAL OR COMMERCIAL MANUFACTURER'S DESIGNATION WITH NEW IDS NAME & ACCEPTABLE PANTONE® DESIGNATIONS						
Source	**Old Federal Color Name and/or Number**	**Other Name and/or Number**	**IDS Name (Generic)**	PANTONE **Color Number**	**Process Number**	**(C-M-Y-K)**
ICI	Salsa # 123		SALSA	PANTONE 18-1444 TPX	83-3 C	30-75-75-0
ICI	Liberty Red # 159		MAROON	PANTONE 19-1540 TPX	69-2 C	20-75-80-30
Generic (no mfg.ref.)	Pastel Sky		PASTEL SKY	PANTONE 12-4607 TPX	247-8 C	20-0-5-3
			SKY BLUE	PANTONE 14-4318 TPX	229-7 C	40-5-5-0
SHERMAN WILLIAMS		JAVA SW6090	NUTMEG BROWN	PANTONE 18-1222 TPX	322-9 C	50-55-55-0

EXTERIOR COLOR CHART		*Southwest USA*		
Building Design Element		**Required Color Standard**	**Color Sample** (See Note 4)	**Notes** (Hyperlinked)
Walls	Base (primary) Material	Tan Brick or native stone		
	Secondary Material	For Almond use PANTONE ® 11-0907 TPX or for Custard use PANTONE 12-0910 TPX		
		For Mocha use PANTONE 16-1210 TPX		
Roof	Sloped Areas	Metal Bronze or Terracotta		
		Clay Terracotta		
		Fiberglass Shingle Gray/White		
	"Flat" Areas	White		

EXTERIOR COLOR CHART		*Southwest USA*		
Building Design Element		**Required Color Standard**	**Color Sample** (See Note 4)	**Notes** (Hyperlinked)
Fenestration	Doors	Wood: For White use PANTONE 11-0604 TPX		
		Steel: For Dark Brown use PANTONE 18-1027 TPX		
	Storm Doors	White		
	Door & Window Frames	For Brown use PANTONE 16-1221 TPX		
	Storm Window or Sash	White		
	Window	White		
Trim Items	Fascia	White		
	Soffit	White		
	Gutters and D.S.	For Brown use PANTONE 16-1221 TPX		
	Awnings and Canopies	For Tan use PANTONE 12-0910 TPX		
	Stair or Balcony Railings, Balusters, and related Trim	For Dark Brown use PANTONE 18-1027 TPX		
	Handrails	For Brown use PANTONE 16-1221 TPX		

Building Design Element		Required Color Standard	Color Sample (See Note 4)	Notes
Trim Items	Fire Escapes	For Dark Brown use PANTONE® 18-1027 TPX		
	Grilles and Louvers	For Brown use PANTONE 16-1221 TPX		
	Coping	For Brown use PANTONE 16-1221 TPX		
	Roof Ventilators	Blend to match roof		
Related Site Structures	Courtyard Enclosure Walls, Retaining Walls, Fences, Dumpster Enclosures	Red Brick or For Dark Brown use PANTONE 18-1027 TPX		
	Porch Crawl Space Enclosure	White		

APPENDIX G

Historic Preservation Guidelines

Most of the history and literature about the military does not deal with the topic of Army facility planning and design processes. However, to plan for the future development of an Army installation, it is necessary to attempt to understand what has taken place there in the past.

In the development of its policies, the Army had to deal with the question of how buildings relate to one another by both use and layout and by architectural characteristics. At least in its earliest phases, this development was not always a conscious formulation of policy so much as it was the immediate response to a given situation. Over the years, different forces have affected the process of military planning in this country. As illustrated by the various districts and zones on Fort Hood.

All questions related to historic properties, districts, and preservation activities should be directed to: 254-287-1092

G.1 HISTORIC PRESERVATION REGULATIONS

The Army's management of historic properties is pursuant to the duties and responsibilities established by Congress under the National Historic Preservation Act (NHPA) of 1966 and its subsequent amendments. This act committed federal agencies to a program of identification and protection of historic properties on the land they own. The NHPA established the Advisory Council on Historic Preservation (ACHP) to "advise the President and the Congress on matters relating to historic

preservation; (and to) recommend measures to coordinate activities of Federal, State, and local agencies." (16 United States Code [U.S.C.] 470j)

The NHPA also created the National Register of Historic Places to designate publicly or privately owned resources and to encourage identification and planning which promotes the compatible use of these properties. The National Register is the official listing of the nation's historic and cultural resources considered worthy of preservation. It includes "districts, sites, buildings, structures, and objects significant in American history, architecture, archaeology, engineering, and culture." (16 U.S.C. 470a)

The NHPA has established a number of procedural steps that federal agencies must meet in order to comply with the intent of the law. This is set forth in Section 106 of the NHPA which requires that: "the head of any Federal agency having direct or indirect jurisdiction over a proposed Federal or federally assisted undertaking in any State and the head of any Federal department or independent agency having authority to license any undertaking shall, prior to the approval of the expenditure of any Federal funds on the undertaking or prior to the issuance of any license, as the case may be, take into account the effect of the undertaking on any district, site, buildings, structure, or object that is included in or eligible for inclusion in the National Register. The head of any such Federal agency shall afford the Advisory Council on Historic Preservation established under Title II of this Act a reasonable opportunity to comment with regard to such undertaking." (16 U.S.C. 470f)

Pursuant to its authority in overseeing the nation's historic preservation programs, the Department of the Interior has developed regulations that amount to a set of acceptable standards for work on properties listed in or eligible for listing in the National Register. The Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation act as a guide to the Advisory Council and State Historic Preservation Offices in their procedural review of Federal undertakings. These guidelines should also act as standards for all federal agencies as they commence planning for any undertaking, which has the potential to trigger Section 106 review, thus assuring that all proposed projects would meet Advisory Council and NHPA requirements.

Federal agencies must comply with the NHPA by following a series of steps detailed in 36 CFR 800. The Army further explains its policies and procedures in Army Regulation (AR) 200-4, *Cultural Resources Management* and Department of the Army Pamphlet (DA PAM) 200-4, *Cultural Resources Management*. This Installation Design Guideline is intended to be used in conjunction with the above regulations, as well as with the Fort Hood Integrated Cultural Resources Management Plan (ICRMP).

The recently developed Army Alternate Procedures (AAP) provide a new method for managing historic properties. The AAP, a streamlined approach to Section 106 of the National Historic Preservation Act, now allows installations to manage historic properties programmatically rather than on a project-by-project review. These procedures also enable installations to leverage existing Army and DoD program requirements while internally managing historic properties in a more efficient and cost-effective manner.

G.2 STANDARDS AND GUIDELINES

G.2.1 Rehabilitation of Historic Properties

Design and renovation guidelines for historic districts are, of necessity, much broader than design guidelines for single structures. Such guidelines must not only address the, appropriate architectural image (style, material, etc.) for proposed new buildings, they must also address how a proposed action within the historic district will impact its integrity, i.e., how any new work will affect the original design intent of the given historic area.

New work should not:

- Conflict with the existing architectural character. For example, it should not:
  - Be larger in mass or taller than the existing historic structures;
  - Be of a color or material that conflicts visually with the predominant historic material used in the area;
  - Destroy the historic fabric of any existing structures or landscape features, which are essential character defining elements within the district; or
  - Destroy the spatial relationship between or among historic buildings designed as a grouping; this includes the regular spacing of buildings within a group, as well as views from one to the other or into the grouping as a whole.

New work should:

- Seek to enhance and protect the historic quality and existing resources. For example:
  - A survey should be conducted to examine the level of use of existing facilities prior to determining the need for new construction; and
  - The Standards and Guidelines for Historic Preservation should be followed, as recommended by the Secretary of the Interior.
- Provide necessary modern conveniences as unobtrusively as possible. For example, it should:
  - Site new construction so that it does not destroy existing building relationships or configurations;
  - Scale new buildings down so as to minimize their visual impact;
  - Place parking to the rear of historic buildings; and
  - Landscape parking areas and modern mechanical equipment so as to screen them from view.
- Phase out (gradually eliminate) existing intrusions. For example, it should:
  - Demolish structures designated as intrusions on the National Register Inventory when they are no longer needed; and
  - Restore buildings that have been altered by inappropriate color schemes, replacement windows, porch enclosures, etc.

G.2.2 Treatment of Historic Fabric

The most effective way to preserve historic properties is to keep them in use and to consistently maintain them. When buildings and grounds are consistently used for their intended purposes and regular maintenance is conducted, there is rarely a need for extensive preservation work. Only when they are misused, underused or left vacant for long periods of time does large-scale rehabilitation become necessary. It follows that if a regular maintenance program is put into effect once a property has been appropriately renovated, another major rehabilitation will rarely be required.

G.2.3 Standards for Historic Preservation Projects

G.2.3.1 Compatible Use of Historic Sites and Structures

Every reasonable effort should be made to use a historic structure or site for its originally intended purpose or to provide a compatible use. The use should be compatible in the sense that it involves minimal alteration to the property and/or has no adverse effect upon its historic integrity. Use of the site and structure should be regulated to prevent alterations that are potentially damaging to historic fabric and/or cultural context.

G.2.3.2 Retention of Character-defining Features

Distinguishing stylistic or character-defining features and examples of skilled craftsmanship should not be destroyed, altered, or removed from a historic site or structure. All such fabric should be treated with sensitivity and preserved in its original context and form.

G.2.3.3 Treatment of Deteriorated Historic Fabric

Deteriorated historic fabric should be repaired rather than replaced whenever possible. When replacement is unavoidable, new material, whether man-made or natural, should match the existing fabric in composition, design, color, texture, and other visual/structural qualities.

G.2.3.4 Documentation of Missing Historic Elements

Replacement of missing historic elements should be based on the accurate duplication of features known to have existed and substantiated by historic pictorial and/or physical evidence and not on conjecture, nor simply on the example of similar treatment found on other structures or sites of the same period or region.

G.2.3.5 Retention of Historic Alterations

Changes to a historic structure or site that have occurred over the course of time may provide evidence of important social or cultural processes. As such, they should be respected and their potential significance carefully evaluated.

G.2.3.6 Unacceptable Alterations

Historic sites and structures should be recognized as products of their own time and as part of an important cultural process. Alterations that have no historical basis or which destroy the authenticity of the place are discouraged.

G.2.3.7 Acceptable Alterations and Additions

When possible, alterations and new additions to historic structures or sites should be done in such a manner as to leave the essential form and integrity unimpaired.

G.2.3.8 Contemporary Design in a Historic Context

Contemporary design for additions to existing historic sites or districts should not be discouraged if such design is compatible with the massing, proportions, scale, materials, color, views, and general contextual relationships of the place.

G.2.3.9 Surface-cleaning Methods

Surface cleaning of structures or buildings should be undertaken with the gentlest possible means, and only when cleaning is essential to the buildings' preservation. Cleaning methods, such as sand blasting, which could damage historic material or speed their deterioration, are discouraged.

G.2.3.10 Archaeological Resources

All treatment work that potentially affects surface or sub-surface pre-historic or historic archaeological resources should be coordinated with an archaeologist.

G.2.3.11 Historic Preservation and Maintenance

The guidelines contained within this IDG are general in nature. The IDG must be used in conjunction with the Installation ICRMP.

G.2.4 Guidelines for Historic Preservation Projects

G.2.4.1 Roof Guidelines

- Preserve existing historic roofing. Repair and patch with matching materials.
- All roofs should receive an annual inspection. Repair and patch all materials as needed, and clean out all gutters and drains.
- When full roof replacement becomes necessary, replace or restore with historic materials.
- Retain and/or maintain roof details, such as all existing chimneys, ventilators, vents, louvers and decorative elements such as brackets, dentils, and cornices. When possible, restore missing decorative elements.

G.2.4.2 Wall Guidelines

- Limestone and brick masonry:
  - Clean only when necessary using the gentlest possible means.
  - Repair or replace deteriorated or missing units as needed.
- Stucco:
  - Repair damaged or deteriorated stucco.
  - Repaint only when necessary with an appropriate color based on analysis of historic paint.
- Wood:
  - Retain or repair wood siding; where replacement is necessary, match existing clapboards in width and species.
  - Repaint only as need to maintain moisture protection.
  - Use color scheme based on analysis of existing paint layers.

G.2.4.3 Porch Guidelines

- Retain or maintain existing original porches.
- Remove historically inappropriate porches.
- Where possible, restore original porches that have been removed or enclosed.

G.2.4.4 Window Guidelines

In most historic districts or buildings, windows constitute a highly visible design element as they make up a large percentage of façades.

- If building an addition or altering the building, maintain height configuration of windows.
- Retain window size and fenestration pattern when replacing windows or altering the building.
- If replacing windows, preserve frame material or use historically accurate reproductions. Avoid replacing original frames with aluminum frames.
- Restore historic windows where non-historic replacement windows have been used.
- Match existing historic windows when possible. The window manufacturing industry can replicate and/or reproduce most all types and sizes of windows to match existing historic windows. In many cases, matching replacement windows are available as stock items.

G.2.4.5 Door Guidelines

Although not usually as visually overpowering as windows, main entrance doorways are also important façade details. As a design element, decorative doors have stylistic features that belong to the particular era for which they were designed.

- Retain or maintain existing historic doors.
- If replacing doors, preserve frame material or use historically accurate reproductions.
- If building an addition or altering the building, maintain the size of the door opening.
- Restore all main entranceways by reinstalling appropriate frames.

G.2.4.6 Color Guidelines

- If historic buildings must be repainted before an accurate color scheme is developed, a conservative approach should be followed. Repaint to match the existing colors or colors that are documented to have been used on that building.
- Use a qualified historic paint color specialist for an inventory and analysis of the paint layer sequences for all building groupings.
- Establish a rotating schedule for the painting and cleaning of each building.

G.2.4.7 Painting Guidelines

- Do not undertake a paint job until any problems with leaking water have been solved. All gutters and downspouts should be repaired and be in good operating condition.
- Only repaint when existing coat is no longer performing, as excessive coats of paint create a thick film that obscures detail.

G.2.4.8 Handicap and Safety Access Guidelines

- As a general rule, buildings listed in or determined eligible for listing in the National Register may receive special consideration for meeting safety and accessibility requirements. Any modifications required to bring a historic structure in compliance with safety and accessibility codes should be carefully planned and undertaken so that they do not adversely affect the design of main entrances or principal facades.
- Where possible, avoid alterations to the main façade and principal doorways.
- Place or install new ramps, lifts, and any added fire escapes on secondary building facades, such as to the side or rear of the building.
- Locate new doorways at the rear or side of the building.
- Required protective railings on ramps, stairs, steps, and lifts should match existing porch railings.

G.2.4.9 Mechanical Equipment Guidelines

- In many cases within historic districts, mechanical equipment is located outside the building. When historic structures are renovated and mechanical systems are upgraded, equipment placement should be planned in order to make the least visual impact.
- Where possible, locate mechanical equipment within the building.
- Screen necessary surface equipment with vegetation.
- When large groups of buildings are upgraded as one project, consider the use of a remote system.

G.2.4.10 Guidelines for Additions

In general, additions should follow all the guidelines for new construction within historic districts, but because their proximity makes the potential for damage to historic fabric even greater, these additional principles that should be followed:

- Avoid changes that impact primary facades.
- Note that some highly visible, freestanding buildings may not have a secondary facade, and thus additions are not advisable.
- Scale down additions to make the least visual impact.
- Design should establish a clear and obvious difference between the existing historic structure and the new addition.

G.2.4.11 Force Protection

These guidelines should be used in conjunction with UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*.

G.3 ARMY STANDARDS

- Army Regulation (AR) 200-4, *Cultural Resources Management*, http://www.usapa.army.mil/pdffiles/r200_4.pdf
- Department of the Army Pamphlet (DA PAM) 200-4, *Cultural Resources Management*, http://www.usapa.army.mil/pdffiles/p200_4.pdf
- The Secretary of the Interior's Standards for the Treatment of Historic Properties, http://www.cr.nps.gov/local-law/arch_stnds_8_2.htm

G.4 REFERENCES AND RESOURCES

- Advisory Council on Historic Preservation, http://www.achp.gov/
- United States Army Environmental Center Historic Buildings
- United States Army Environmental Center Native Indian Affairs
- United States Army Environmental Center Archeology

APPENDIX H

Housekeeping Rules

The following set of housekeeping rules consists of a list of general and public rules that are applicable to the administrative office work areas throughout the installation. Organizations should make every effort to assure that all personnel are familiar with the facilities housekeeping rules. An organized, well-kept working area that is neat and clean contributes to the visual harmony of the work area and fosters work efficiencies. Modify these housekeeping rules, as appropriate.

HOUSEKEEPING RULES FOR FORT HOOD FACILITIES

General Rules:

1. **Alterations:** Employees shall not mark, paint, drill, damage, string wires within, or in any way deface any part of the building. Employees will not install or permit the installation of any awnings, shades, Mylar films, or num filters on windows. Employees will not obstruct, alter, or in any way impair the efficient operation of the heating, ventilating, air conditioning, electrical, fire safety, or lighting systems, nor shall the employee tamper with or change the setting of any thermostat or temperature control valve in the building. Employees shall not cover or block air ducts or vents.

2. **Cleanliness:** Employees shall exercise their best efforts to keep workstations and common areas, i.e., hallways, corridors, team rooms, etc., clean and free from rubbish. No employee shall cause any unnecessary labor on the part of cleaning personnel due to carelessness or indifference in the preservation of good order and cleanliness. It is highly recommended that employees use covered cups when transporting liquids to and from the coffee bars. Employees shall not bring any substance into the building that might add an undue burden to the cleaning or maintenance of the premises or the building.

3. **Carpet:** Carpet stains and/or damage should be reported to (Enter Point of Contact [POC]).

4. **Energy Conservation:** Turn off systems furniture lighting, conference room lights, private office lights and equipment, etc. when not in use, especially at the end of the day. During non-business hours, employees shall limit the use of lighting and equipment to occupied areas.

5. **Lighting:** Do not move and /or modify any overhead lighting fixtures above workstations. One task light may be placed in a workstation.

6. **Vertical and Venetian Blinds:** Blinds are to be left in a fully extended position at all times. Blades shall be positioned so as to permit a good level of natural lighting and shall only be closed for the purposes of sun control and at night for privacy. Only the wands will be used for adjustments. Items shall not be placed or stored on windowsills other than small plants as described hereinafter.

7. **Signage:** No signs, advertisements, or notes shall be painted or affixed on or to any window, door, restroom conference/team room, or other part of the building unless approved by (Enter POC). Bulletin boards for posting of unofficial material are restricted to communal areas such as break rooms and coffee bars.

8. **Bicycles:** Employees shall not bring bicycles or motorcycles into the office environment, but shall be left secured in an upright position in areas designated for that purpose.

9. **Aerosol Sprays:** The use of aerosol products such as air fresheners, hair sprays, etc. in the work environment should be avoided.

10. **Maintenance:** All requests for maintenance on furnishings, or building systems or components should be reported to (Enter POC [there may be more than one POC]).

11. **Smoking:** The use of tobacco products inside any Army facility is strictly prohibited. Smoking of tobacco products may only occur in designated areas where proper ash receptacles, which are kept free of trash and debris, are located.

Public Spaces:

1. **Eating in Work Areas:** Eating in work areas can contribute to pest infestation and an unsightly appearance. If eating at your desk, please ensure trash is discarded daily. Perishable food items should not be stored in the employees' work area. Perishable foods are to be kept refrigerated.

2. **Appliances (**e.g., heaters/refrigerators/microwaves/coffee pots): Refrigerators and microwaves are not permitted in work areas. One personal fan, not to exceed 8 inches in diameter may be placed in a workstation. Exceptions to accommodate health problems may be submitted to (Enter POC).

3. **Centralization:** Copiers, faxes, scanners, printers, etc., will be centralized and networked to the maximum extent possible. Personal office equipment will be provided on an exception basis only.

4. **Office Accessories:** All office equipment and other devices of any electrical or mechanical nature shall be placed on an area of the work surface that best accommodates the prevention/elimination of any vibration, noise, or annoyance to others. Employees shall not construct, maintain, use, or operate any equipment of machinery that produces music, sound, noise, pictures, or lighting which is audible or visible beyond their workstation.

5. **Office Wall Mountings:** Only framed items shall be hung on walls. No artwork or other displays may be placed or hung on fixed or temporary walls/partitions, other than in private offices, without approval by (Enter POC). The use of tape, pushpins, or other devices to affix items to walls is prohibited.

6. **Plants:** Plants must be contained in appropriate leak-proof non-corroding containers such as ceramic jardinières or flower pots with saucers and shall be kept within workstations and not affixed in any way to the workstation, partitions, floors, or ceiling as outlined in the guidance detailed elsewhere in this document; this prohibition extends to trailing vines. Small plants that do not interfere with the normal operation of window blinds may be placed on windowsills. Watering of plants shall not subject any government equipment to risk of damage.

7. **Speakerphones:** The use of speakerphones is discouraged and should be restricted to those occasions when absolutely necessary. Concerted efforts must be made to utilize team rooms when speakerphone conversations are required.

8. **Trash:** The janitorial contractor will discard only items in wastebaskets or items clearly labeled "TRASH." Do not place trash in the corridors, hallways, stairwells, or other common areas.

9. **Workstation Reconfiguration:** Workstations will not be reconfigured, modified, or altered in any way by the occupant.

10. **Workstation Guidelines:** Every employee shall make a concerted effort to keep workstations clean, uncluttered, and professional in appearance. Avoid placing papers and other "hard copy" materials on the wall of the workstation and the accumulation of excessive pictures/cartoons/mementos. The storage of papers, boxes, and files on floors is prohibited. Materials are not to be hung on the outside panels of workstations.

    a. **Above the Panels:** Nothing will be placed above the panel height of the workstations or hung from the ceiling. Nothing will be stacked on the tops of flipper doors, map files, filing cabinets, towers, etc.

    b. **Cabling:** No temporary cabling for electrical, information technology, or communications is allowed. Requests for alterations must be submitted to (Enter POC). This prohibition includes extension cords; surge protectors are permitted. Wiring is to be contained in cable trays and off the floors.

11. **Care of Furniture and Furniture Systems**

    a. **Laminate Surfaces:** To clean laminate tops, use a soft cloth or non-abrasive sponge dampened in a solution of mild detergent and warm water. Remove residue of cleaning solution with a soft cloth wrung out in clean water. Dry with a soft cloth.

    b. **Steel and Painted Metal Surfaces:** Panel trim, panel poles, painted flipper doors, and other parts of flipper doors should be cleaned with a soft damp cloth and thoroughly dried with a soft dry cloth. For soiled areas, a mild detergent solution in warm water may be used.

    c. **Fabric:** For information on how to remove spots from fabric panels on workstations, contact (Enter POC).

APPENDIX I

Plant Palette

Approved Plant List for Landscaping on Fort Hood		
Large Trees		
Big-tooth maple*	*Acer grandidentatum*	interesting leaves; grows 20 to 50 feet; needs very little water; golden to red fall color
Bur oak*	*Quercus macrocarpa*	very large shade tree; grows 60 to 80 feet tall and 50 feet spread; needs deep, rich soil; very large leaves; large interesting acorns
Cedar elm*	*Ulmus crassifolia*	grows up to 70 feet; upright growth form that is good for narrow spaces; yellow-golden fall color
Chinkapin oak*	*Quercus muehlenbergii*	grows up to 50 feet; prefers deeper soil, but will grow in dry soil; large leaves; yellow to brown fall color
Escarpment black cherry	*Prunus serotina* var. *eximia*	grows up to 25 feet; white flower clusters followed by small black cherries; yellow fall color; needs moist soil
Lacey oak	*Quercus laceyi* (or *Q. glaucoides*)	grows up to 20 feet; slow growth rate; interesting blue-green leaf color; not susceptible to oak wilt
Monterrey oak, or Mexican white oak	*Quercus polymorpha*	grows up to 40 feet; deciduous to evergreen; prefers well-drained soil; the young leaves are bronze in color; not susceptible to oak wilt
Pecan*	*Carya illinoenensis*	grows up to 90 feet; large shade tree; needs deep, rich soil; birds and people eat the nuts
Plateau live oak*	*Quercus fusiformis* (or *Q. virginiana*)	grows up to 30 feet; evergreen; large shade tree; needs very little water; susceptible to oak wilt
Texas white ash* (NOT Arizona ash, or Fan Tex ash)	*Fraxinus texensis* (NOT *Fraxinus velutinus*)	grows 40 to 50 feet; grows fairly fast; yellow to orange fall color; needs very little water

Approved Plant List for Landscaping on Fort Hood		
Small Trees		
Blanco crabapple	*Pyrus ioensis* var. *texana* (*Malus ioensis* var. *texana*)	sun; grows up to 12 feet; pink flowers in the spring and interesting fruits in the fall
Carolina buckthorn*	*Rhamnus caroliniana (Frangula caroliniana)*	sun or shade; grows up to 15 feet; large glossy leaves; small purple fruits in late fall
Desert willow	*Chilopsis linearis*	sun or part shade; grows up to 15 feet; large showy pink flowers; does not like to be over watered
Eve's necklace*	*Sophora affinis*	sun or shade; grows up to 20 feet; delicate pink flowers in spring; smooth green bark; interesting bead-like fruit
Mexican plum*	*Prunus mexicana*	sun or part shade; grows up to 20 feet; one of the first to flower in the spring; beautiful white, fragrant flowers; interesting flaky bark
Prairie flame-leaf sumac*	*Rhus lanceolata*	prefers full sun; grows 10-20 feet; small white flowers in the summer; birds will love the red berries; brilliant red color in the fall; will spread to become several small trees, needs room to expand
Rusty blackhaw viburnum*	*Viburnum rufidulum*	sun or shade; grows 10-20 feet; large white flower clusters in spring; red fall color
Smoketree	*Cotinus obovatus*	sun or part shade; grows 12-20 feet; prefers dry soil; interesting flowers/fruit, looks like smoke; orange fall color
Texas redbud*	*Cercis canadensis* var. *texensis*	sun or part shade; grows 20-30 feet; one of the first to flower in spring; beautiful pink flowers
Tall Shrubs		
Deciduous holly*	*Ilex decidua*	sun or part shade; grows 12-20 feet; deciduous; striking red berries on females in fall that persist into winter
Dwarf wax myrtle	*Myrica pusilla*	sun or part shade; evergreen; grows 8-12 feet; golden yellow flowers; small blue fruits are eaten by many different birds
Evergreen sumac*	*Rhus virens*	prefers full sun; thick evergreen foliage, but will turn bronze after a freeze; grows 4-12 feet tall and 6-8 feet wide; red berries in late fall; does not like to be over watered
Golden-ball lead tree	*Leucaena retusa*	sun or part shade; prefers dry soil and does not like to be over watered; grows up to 12 feet; flowers are yellow puffs in spring, summer, and fall
False indigo*	*Amorpha fruticosa*	plant this one where your soil stays wet; grows up to 12 feet; beautiful dark purple tiny flowers in spring
Mexican buckeye*	*Ungnadia speciosa*	sun or shade; grows 12-20 feet tall and 12-20 feet wide; pink flowers in early spring; brilliant yellow fall color; interesting seed pods are left behind after the leaves fall
Prickly ash*, toothache tree, or tickle-tongue	*Zanthoxylum hirsutum*	sun or part shade; grows up to 15 feet; interesting fragrant foliage; has many sharp spines (do not plant this one too near sidewalks); swallowtail butterfly larvae use this plant

Approved Plant List for Landscaping on Fort Hood		
Silktassel	*Garrya ovata* var. *lindheimeri (Garrya lindheimeri)*	evergreen; full sun; prefers dry soil; grows 3-12 feet; silvery-grey leaves
Texas mock orange	*Philadelphus texensis*	sun or part shade; grows up to 12 feet; white flowers in late spring and early summer
Texas mountain laurel*, or Mescal bean	*Sophora secundiflora*	sun or part shade; evergreen; grows 10-20 feet; beautiful fragrant purple flowers; seeds are poisonous if eaten; be patient with this plant, it grows very slowly
Texas pistache (not Chinese pistache)	*Pistacia texana* (not *Pistacia chinensis*)	sun; evergreen; grows 12-30 feet tall and 15-20 feet wide; prefers dry soil; leaves are small and glossy
Wafer-ash*, or hop tree	*Ptelea trifoliata*	sun or shade; grows 3-12 feet; interesting fragrant foliage and fruit; swallowtail butterfly larvae use this plant
Wax myrtle	*Myrica cerifera*	sun or part shade; evergreen; grows up to 15 feet; golden yellow flowers; small blue fruits are eaten by many different birds
Witch hazel	*Hamamelis virginiana*	prefers shade, but can take sun; grows up to 30 feet; golden yellow fall color; interesting yellow flowers in the late fall after the leaves drop
Low Shrubs		
Agarita*, or agarito, or algaritas	*Berberis trifoliolata*	sun or shade; evergreen; spiny leaves (do not plant this one too near sidewalks); grows 3-6 feet tall and 3-6 feet wide; one of the first to flower in the spring; fragrant yellow flowers followed by small red berries
Black dalea*	*Dalea frutescens*	sun; grows 1-3 feet tall and 3-4 feet wide; very small, delicate leaves; purple flowers in the summer and fall
Butterfly bush	*Buddleja marrubiifolia*	sun or part shade; semi-evergreen; grows 4-6 feet tall and 4-6 feet wide; silvery-grey leaves; orange flowers summer and fall that attract butterflies
Chili piquin	*Capsicum annuum*	prefers shade; grows 2-3 feet; small white flowers in summer and fall; small red fruits following the flowers attract birds
Flame acanthus	*Anisacanthus quadrifidus* var. *wrightii*	full sun or part shade; grows 3-4 feet; flowers are red or orange from summer to fall and attract hummingbirds and butterflies
Fragrant mimosa*, or pink mimosa	*Mimosa borealis*	prefers sun; prefers dry soil; has many sharp hooked spines (do not plant this one too near sidewalks); grows 3-7 feet tall; many beautiful pink flowers in early spring
Gregg dalea	*Dalea greggii*	prefers full sun; grows up to 1 foot tall and 2-4 feet wide; works as a ground cover; prefers dry soil; flowers summer and fall
Gregg sage, or cherry sage	*Salvia greggii*	full sun; evergreen; grows up to 3 feet tall; flowers range in color from red to pink to white; attracts hummingbirds; spring, summer, and fall
Mexican oregano	*Poliomentha longiflora*	prefers sun; evergreen; grows up to 3 feet tall and up to 3 feet wide; pink flowers spring, summer, and fall that attract hummingbirds

Approved Plant List for Landscaping on Fort Hood		
Mountain sage	*Salvia regla*	prefers part shade; grows 3-6 feet tall and 3-4 feet wide; plant this one where your soil stays damp; red flowers in the fall that attract hummingbirds
Shrubby blue sage, or mejorana	*Salvia ballotiflora*	prefers sun; grows up to 6 feet tall; flowers spring, summer, and fall; fragrant (minty) leaves
Shrubby boneset*, fragrant white mistflower, or thorouthwort	*Eupatorium havanense*	needs some shade; grows 3-5 feet tall and 3-5 feet wide; white flowers in the late summer and fall that attract butterflies
Skunkbush*, or aromatic sumac	*Rhus trilobata (Rhus aromatica)*	sun or part shade; usually grows less than 3 feet tall, and 3-5 feet wide; delicate small leaves; red berries in the fall; leaves turn brilliant red in the fall
Turk's cap*	*Malvaviscus arboreus* var. *drummondii*	prefers shade; grows 2-6 feet tall and 3-5 feet wide; red flowers summer and fall that attract butterflies and hummingbirds
Yaupon holly	*Ilex vomitoria*	sun or shade; evergreen; grows 12-20 feet tall and 10-15 feet wide (dwarf varieties available that grow 2-4 feet tall and 2-4 feet wide); red berries on females
Vines		
Coral honeysuckle	*Lonicera sempervirens*	full sun; evergreen; elongate red flowers in early spring and some flowers in summer; attracts butterflies and hummingbirds
Crossvine	*Bignonia capreolata*	sun or part shade; evergreen; large orange flowers in the spring
Lindheimer's morning glory	*Ipomoea lindheimeri*	sun or part shade; delicate perennial; large pale purple flowers
Purple leather flower*	*Clematis pitcheri*	sun or part shade; delicate perennial; purple flowers with leathery petals
White bush honeysuckle*	*Lonicera albiflora*	prefers sun; grows as a shrub or a vine; small white flowers are quite fragrant; attracts butterflies; red berries in summer
Virginia creeper*	*Parthenocissus quinquefolia*	sun or part shade; interesting leaves; bird will eat the berries; bright red fall color
Xerophytes – plants that are adapted to especially dry soil conditions		
Devil's shoestring*	*Nolina lindheimeriana*	sun; prefers dry soil; smaller clusters of leaves with tall flower stalks
Lechuguilla	*Agave lechuguilla*	sun; prefers very dry soil; interesting spiny foliage; very tall flower stalks; spreads by offshoots and needs lots of room to expand
Texas sotol	*Dasylirion texanum*	sun; prefers dry soil; grows 3-4 feet across; interesting spiny foliage; very tall flower stalks
Red yucca	*Hesperaloe parviflora*	sun; prefers dry soil; red flowers on a tall stalk; attracts hummingbirds
Spanish dagger	*Yucca treculeana* or *Yucca torreyi*	sun; prefers dry soil; grows 3-12 feet tall; leaves are stiff and spear-like (do not plant this one too near sidewalks); white flowers in spring
Texas sacahuista*, or basket grass	*Nolina texana*	sun; prefers dry soil; large clusters of leaves, grows 3 feet across; white flowers hidden within leaves

Approved Plant List for Landscaping on Fort Hood		
Perennial Flowers		
Aromatic aster*, or fall aster	*Aster oblongifolius*	sun or part shade; grows 2-3 feet tall and 2-3 feet wide; purple flowers in the fall
Big red sage	*Salvia penstemonoides*	sun or part shade; grows 3-4 feet tall and 1-2 feet wide; magenta flowers summer and fall that attract hummingbirds
Blackfoot daisy*	*Melampodium leucanthum*	full sun; prefers dry soil; grows up to 1 foot tall, and 1-2 feet wide; white flowers during spring, summer, and fall
Bushy skullcap*	*Scutellaria wrightii*	full sun; grows up to 1 foot tall and 1 foot wide; lots of small purple flowers spring, summer, and fall
Canyon sage	*Salvia lycioides*	flowers spring and fall
Cedar sage*	*Salvia roemeriana*	needs shade; evergreen; grows 1-2 feet tall and 3 feet wide; red flowers in spring that attract hummingbirds
Chocolate daisy, or lyre-leaf green eyes	*Berlandiera lyrata*	yellow daisy flowers from summer to fall
Damianita	*Chrysactinia mexicana*	prefers sun; grows 1-2 feet tall and 1-2 feet wide; yellow flowers; does well at dry sites
Engelmann daisy*, or cutleaf daisy	*Engelmannia pinnatifida (Engelmannia peristenia)*	full sun; yellow flowers in spring and summer
Fall obedient plant, or false dragon-head	*Physostegia virginiana*	shade or part sun; grows 2-4 feet tall and up to 2 feet wide; purple flowers in the fall
Gaura*	*Gaura lindheimeri*	sun or part shade; grows 2-4 feet tall and 3 feet wide; pink to white flowers spring and summer
Gayfeather*	*Liatris mucronata*	prefers sun; grows 1-2 feet tall; purple flowers in the fall
Giant blue sage*	*Salvia azurea*	full sun; grows 3-6 feet tall; delicate blue flowers
Goldenrod*	*Solidago canadensis* (or *S. nemoralis*)	full sun; grows 2-5 feet tall; abundant yellow flowers in the fall; prefers dry soil
Heath aster*	*Aster ericoides*	sun; grows 1-2 feet tall and up to 1 foot wide; numerous small white flowers in the fall
Hill Country penstemon, or Scarlet penstemon	*Penstemon triflorus*	sun or part shade; prefers dry soil; grows 1-2 feet tall and 1-2 feet wide; pinkish-red flowers in spring and summer
Mealy sage*	*Salvia farinacea*	full sun; 1-3 feet tall and 1-2 feet wide; prefers dry soil; purple flowers
Pigeonberry*	*Rivina humilis*	prefers shade; 1-2 feet tall and up to 2 feet wide; white flowers and bright red fruits from summer to fall
Pink skullcap	*Scutellaria suffretescens*	sun or part shade; each plant can spread to 2 feet wide; dark pink flowers spring, summer, and fall
Prairie larkspur*	*Delphinium carolinianum*	sun or part shade; white or blue flowers along 1-3 feet tall stalks

Approved Plant List for Landscaping on Fort Hood		
Prostrate lawnflower*, or horseherb	*Calyptocarpus vialis*	part sun or shade; small yellow flowers spring, summer, and fall; a low-growing ground cover
Purple cone-flower*	*Echinacea angustifolia*	sun or part shade; grows 1-2 feet tall; large purple flowers in the spring and summer that attract butterflies
Red columbine*	*Aquilegia canadensis*	needs shade; plant this one where your soil stays damp; grows 1-3 feet tall and 1-2 feet wide; interesting leaves; beautiful red flowers that attract hummingbirds
Rock penstemon, or cut-leaf penstemon	*Penstemon baccharifolius*	prefers dry soil; grows up to 2 feet tall; large red flowers in spring, summer, and fall
Texas betony	*Stachys coccinea*	prefers shade; grows 1-2 feet tall and 2-3 feet wide; leaves are gray-green in color; red flowers in the spring, summer, and fall
Texas rock rose, or rose pavonia	*Pavonia lasiopetala*	sun or part shade; grows 1-3 feet tall and 2-3 feet wide; pink flowers during the summer and fall that attract butterflies
Texas star hibiscus	*Hibiscus coccineus*	full sun; grows up to 4 feet tall and up to 4 feet wide; orange star-like flowers all summer and into the fall
Tropical sage*	*Salvia coccinea*	sun or shade; grows up to 3 feet tall, and 1-2 feet wide; red flowers in spring, summer, and fall that attract butterflies and hummingbirds
Wild fox-glove*	*Penstemon cobaea*	sun; prefers dry soil; grows 1-2 feet tall; large white flowers in spring
Wood fern*, or river fern	*Thelypteris kunthii*	prefers shade; plant this one where your soil stays damp; grows 2-5 feet tall and up to 3 feet wide
Woolly ironweed*	*Vernonia lindheimeri*	full sun; prefers dry soil; grows 1-2 feet tall; lots of small purple flowers in the summer
Ornamental (tall) Grasses		
Big bluestem*	*Andropogon gerardii*	full sun or part shade; grows 3-5 feet tall and needs lots of room to spread; flowers in the fall
Bull muhly	*Muhlenbergia emersleyi*	full sun or part shade; grows 3-5 feet tall; flowers in the fall have a purplish color
Indian grass*, or yellow Indian grass	*Sorghastrum nutans*	prefers full sun, can grow in part shade; grows 3-5 feet tall and needs lots of room to spread; yellow fall color
Lindheimer's muhly* or big muhly	*Muhlenbergia lindheimeri*	a clump grass to use instead of Pampas grass; grows 3-5 feet tall and 3 feet wide; flowers in the fall
Little bluestem*	*Schizachyrium scoparium*	sun; grows 2-5 feet tall and needs lots of room to spread; leaves are blue-green in color and the flower stalks turn bronze after the first frost
Mexican feather grass	*Stipa tenuissima*	sun to part shade; grows 1-2 feet tall; leaves are thin and bright green; flowers in late summer
Pine muhly	Muhlenbergia dubia	prefers full sun; prefers dry soil; grows 1-2 feet tall; leaves are gray-green in color

Approved Plant List for Landscaping on Fort Hood		
Turf Grasses		
Buffalo grass*	*Buchloe dactyloides*	prefers sun; grows very short and needs very little mowing; needs very little water once established; does not respond to fertilizer; spreads by seeds as well as by runners; needs to be weeded until established
Bermuda grass	*Cynodon dactylon*	sun or shade; grows short and needs little mowing; needs only moderate amounts of water (1 inch per week); will invade into nearby beds
Zoysia, or zoysiagrass or Manilla zoysia	*Zoysia matrella* or *Zoysia japonica*	sun or part shade; forms a dense turf; needs only moderate amounts of water (1 inch per week)
Native sun turf grass mix (blue grama and buffalograss mix, 34/66%)	*Bouteloua gracilis* and *Buchloe dactyloides*	full sun; available as seed only, plant spring to summer; grows short and needs very little mowing; needs very little water once established; does not respond to fertilizer

*Indicates plants native to Fort Hood.

J.1 STANDARDS AND REFERENCES

Standards and References for the Army Installation Design Standards (IDS).

J.1.1 Chapter 2, Site Planning Design Standards

J.1.1.1 Army Standards

- Americans with Disabilities Act Accessibility Guidelines (ADAAG)
- Uniform Federal Accessibility Standards (UFAS)
- Army Regulation (AR) 200-2, *Environmental Effects of Army Actions*
- Army Regulation (AR) 210-20, *Master Planning for Army Installations*
- Army Regulation (AR) 415-15, *Army Military Construction Program Development and Execution*
- Army Regulation (AR) 420-70, *Buildings and Structures*

J.1.1.2 References

- Unified Facilities Criteria (UFC) *2*-600-01, *Installation Design*, Chap 7
- Unified Facilities Criteria (UFC) *3-400-01*, Design: Energy Conservation
- Unified Facilities Criteria (UFC) *3-210-01A*, Design: Area Planning, Site Planning, and Design
- Unified Facilities Criteria (UFC) *3-210-06A*, Design: Site Planning and Design
- Unified Facilities Criteria (UFC) *3-230-15FA*, Design: Subsurface Drainage Facilities for Airfields and Heliports
- Unified Facilities Criteria (UFC) *3-230-16FA*, Design: Drainage and Erosion Control Structures for Airfields and Heliports
- Unified Facilities Criteria (UFC) *3-230-17FA*, Design: Drainage for Areas Other than Airfields
- Unified Facilities Criteria (UFC) *3-230-18FA*, Design: General Provisions and Geometric Design for Roads, Streets, Walks, and Open Storage Areas
- Unified Facilities Criteria (UFC) *3-260-02*, Design: Pavement Design for Airfields
- Unified Facilities Criteria (UFC) *3-250-01FA*, Design: Pavement Design for Roads, Streets, Walks and Open Storage Areas
- Technical Instructions (TI) 800-01, *Design Criteria*
- Technical Instructions (TI) 801-02, *Family Housing*
- Master Planning Instructions (MPI)
- Whole Building Design

J.1.2 Chapter 3, Building Design Standards

J.1.2.1 Army Standards

- Army Regulation (AR) 200-4, *Cultural Resources Management*
- Army Regulation (AR) 420-70, *Buildings and Structures*
- Unified Facilities Criteria (UFC) 3-520-01, *Interior Electrical Systems*
- Unified Facilities Criteria (UFC) 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*
- UFC 4-171-05, *Design: Guide for Army Reserve Facilities*
- Americans with Disabilities Act Accessibility Guidelines (ADAAG)
- Uniform Federal Accessibility Standards (UFAS)
- Secretary of the Interior's Standards for the Treatment of Historic Properties
- Technical Manual (TM) 5-807-10, *Signage*
- Technical Instructions (TI) 809-04, *Seismic Design for Buildings*
- Technical Instructions (TI) 809-05, *Seismic Design Evaluation and Rehabilitation for Buildings*
- Technical Manual (TM) 5-809-10/Navy NAVFAC P-355/Air Force AFM 88-3, Chap 13, *Seismic Design for Buildings*
- Technical Manual (TM) 5-809-10-2/Navy NAVFAC P-355.2/Air Force AFM 88-3, Chap 13, Sec B, *Seismic Design Guidelines for Upgrading Existing Buildings*
- U.S. Army Corps of Engineers Engineering Technical Letter (ETL) 1110-3-502, Telephone and Network Distribution System Design and Implementation Guide
- Standards of Seismic Safety for Existing Federally Owned and Leased Buildings
- Army Barracks Master Plan, Appendix I, Army Barracks Standards
- Memorandum Subject: Revised Barracks Construction Criteria, dated 1 May 2003

- Quality Standards for New and Replacement Residential Communities Initiative (RCI) Family Housing
- Army Lodging Standards
- Design Manual for Remoted Target Systems (RETS) Ranges, CEHNC 1110-1-23 Manual
- Unexploded Ordinance Considerations in the Planning, Design, and Construction of Ranges, Supplement to CEHNC 1110-1-23 Manual
- Revised Range Design/Construction Interface Standards
- Army Chapel Standard Definitive Design
- Army Standard for Chapel Construction – January 2004 and Memorandum for Record, subject: The Army Standards for Chapels, dated 21 January 2004.
- Army Standards for Company Operation Facility (COF)
- Army Standards for Child Development Center Construction (for school-age children) October 2004

J.1.2.2 References

- Army Regulation (AR) 190-13, *The Army Physical Security Program*
- Army Regulation (AR) 200-1, *Environmental Protection and Enhancement*
- Army Regulation (AR) 200-2, *Environmental Effects of Army Actions*
- Army Regulation (AR) 200-4, *Cultural Resources Management*
- Army Regulation (AR) 210-20, *Master Planning for Army Installations*
- Army Regulation (AR) 210-21, *Army Ranges and Training Land Program*
- Army Regulation (AR) 405-45, *Real Property Inventory Management*
- Army Regulation (AR) 405-70, *Utilization of Real Property*

- Unified Facilities Criteria (UFC) 2-600-01, *Installation Design*, Chap 8
- Unified Facilities Criteria (UFC) 4-510-01, *Design: Medical Military Facilities*
- Unified Facilities Criteria (UFC) 1-200-01, *Design: General Building Requirements*, 31 July 2002
- Unified Facilities Criteria (UFC) *3-400-01*, Design: Energy Conservation
- Unified Facilities Criteria (UFC)3-130-07, Arctic and Subarctic Construction - Buildings
- Unified Facilities Criteria (UFC) 3-301-05A, Design: Seismic Evaluation and Rehabilitation for Buildings
- Unified Facilities Criteria (UFC) 3-300-10, Structural Engineering
- Unified Facilities Criteria (UFC)3-310-03A, Design: Seismic Design for Buildings
- Unified Facilities Criteria (UFC) 3-120-02AN, Design Guide for Interiors
- Engineering Regulation (ER) 1110-345-122, *Engineering and Design, Interior Design*
- Department of the Army Pamphlet (DA PAM) 200-4, *Cultural Resources Management*
- U.S. Army Corps of Engineers, Design Guide (DG) 1110-3-122, *Design Guide for Interiors*
- Department of Defense (DoD) Interior Design Website
- Technical Instructions (TI) 800-01, *Design Criteria*
- Technical Instructions (TI) 811-16, *Lighting Design*
- Technical Manual (TM) 5-683, *Electrical Interior Facilities*
- Technical Manual (TM) 5-688, *Foreign Voltage and Frequencies Guide*
- Army Barracks Master Plan
- Air Force Interior Design Guides

- Office of the Assistant Secretary of the Army for Financial Management and Comptroller (OASA [FM&C]) Sales and Outlease of Army Assets - Installation Guide
- Assistant Chief of Staff for Installation Management, Sustainable Design and Development Website
- U.S Army Corps of Engineers, Engineering Research and Development Center, Construction Engineering Research Laboratory (CERL), Sustainable Design and Development Website
- U.S. Army Corps of Engineers Engineering Technical Letter (ETL) 1110-3-502, Telephone and Network Distribution System Design and Implementation Guide
- Whole Building Design Guide
- Unified Facilities Guide Specifications (UFGS), "Division 12 - Furnishings", Construction Criteria Base
- Engineering and Construction Bulletins
- Assistant Secretary of the Army memorandum Subject: Sustainable Design and Development Requirements, dated 18 March 2003

J.1.3 Chapter 4, Circulation Design Standards

J.1.3.1 Army Standards

- Army Regulation (AR) 420-72, *Transportation Infrastructure and Dams*
- Technical Manual (TM) 5-811-1/Air Force AFJMAN 32-1080, *Electric Power Supply and Distribution*
- Technical Manual (TM) 5-850-2/Air Force AFJMAN 32-1046, *Railroad Design and Rehabilitation*
- Manual For Railway Engineering
- Unified Facilities Criteria (UFC) 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*
- Unified Facilities Criteria (UFC) 3-210-02, Design: POV Site Circulation and Parking

- Unified Facilities Criteria (UFC) 3-230-18FA, Design: General Provisions and Geometric Design for Roads, Streets, Walks, and Open Storage Areas
- Unified Facilities Criteria (UFC) 3-260-02, Design: Pavement Design for Airfields
- Americans with Disabilities Act Accessibility Guidelines (ADAAG)
- Uniform Federal Accessibility Standards (UFAS)
- Manual of Uniform Traffic Control Devices (MUTCD)
- Chicago's Bike Lane Design Manual (Provides a comprehensive series of technical drawings and design specifications for bike lanes).

J.1.3.2 References

- Unified Facilities Criteria (UFC) *2*-600-01, *Installation Design*, Chap 9
- U.S. Air Force, Landscape Design Guide, Parking Area
- U.S. Air Force, Landscape Design Guide, Walkways and Bikeways (Provides a comprehensive walkways and bikeways planning guide including sections on paving materials and gradients and curvature data).
- Illumination Engineering Society of North America (IESNA)
- Federal Highway Administration reference document "Accessible Sidewalks and Street Crossings – an informational guide".

J.1.4 Chapter 5, Landscape Design Standards

J.1.4.1 Army Standards

- Unified Facilities Criteria (UFC) *3-210-05FA*, Design: Landscape Design and Planting Criteria
- Army Regulation (AR) 420-70, *Buildings and Structures*
- Technical Manual (TM) 5-630, *Natural Resources Land Management*
- American Standard for Nursery Stock, ANSI Z60.1

- Overseas (Host Nation Standards)

J.1.4.2 References

- Unified Facilities Criteria (UFC) *2*-600-01, *Installation Design*, Chap 10
- USAF Landscape Design Guide
- C. Brickell and D. Joyce. Pruning and Training, 1996

J.1.5 Chapter 6, Site Elements Design Standards

J.1.5.1 Army Standards

- DoD 4525.8-M, DoD Official Mail Manual
- Army Regulation (AR) 420-49, Utility Services
- Army Regulation (AR) 420-70, Buildings and Structures
- Army Regulation (AR) 420-72, Transportation Infrastructure and Dams
- Americans with Disabilities Act Accessibility Guidelines (ADAAG)
- Uniform Federal Accessibility Standards (UFAS)
- Technical Manual (TM) 5-807-10, Signage
- Manual of Uniform Traffic Control Devices (MUTCD)
- MTMC Pamphlet 55-14, Traffic Engineering for Better Signs and Markings
- Unified Facilities Criteria (UFC) 4-010-01, DoD Minimum Antiterrorism Standards for Buildings

J.1.5.2 References

- Unified Facilities Criteria (UFC) 2-600-01, Installation Design
- Unified Facilities Criteria (UFC) 2-600-01, Installation Design, Chap 11
- Army Regulation (AR) 1-33, Memorial Programs

- Army Regulation (AR) 840-1, Department of the Army Seal, and Department of the Army Emblem and Branch of Service Plaques
- Technical Instructions (TI) 811-16, Lighting Design
- Technical Manual (TM) 5-663, Child Development Center, Play Area Inspection and Maintenance Program
- Unified Facilities Criteria (UFC) 3-210-04, Design: Children's Outdoor Play Areas
- National Fire Protection Association (NFPA) 291, Recommended Practice for Fire Flow Testing and Marking of Hydrants
- Advisory Circular AC 70/7460-1K, Obstruction Marking and Lighting

J.1.6 Chapter 7, Force Protection Design Standards

J.1.6.1 Army Standards

- Unified Facilities Criteria (UFC) 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*
- Unified Facilities Criteria (UFC) 4-010-10, *DoD Minimum Antiterrorism Standoff Distances for Buildings*. (This document is a "For Official Use Only [FOUO]" publication. Users may contact the Point of Contact posted at the noted website for inquires regarding this document).
- Uniform Federal Accessibility Standards (UFAS)
- Americans with Disabilities Act Accessibility Guideline (ADAAG)
- DoD Instruction 2000.16, DoD Antiterrorism Standards

J.1.6.2 References

- Unified Facilities Criteria (UFC) *2*-600-01, *Installation Design,* Chap 12
- DoD Handbook 2000.12-H, *Protection of DoD Personnel and Activities Against Acts of Terrorism and Political Turbulence*, February 1993 (This Handbook is a "For Official Use Only [FOUO]" publication. Users may contact the Point of Contact posted at the following website to obtain a copy of the Handbook). http://www.dtic.mil/whs/directives/corres/html/o200012h.htm

- Army Regulation (AR) 525-13, The Army Force Protection Program (Available only through the Army Knowledge Online web portal).

- **UFC 4-022-01, *Security Engineering: Entry Control Facilities / Access Control Points*** (http://www.wbdg.org/ccb/DOD/UFC/ufc_4_022_01.pdf).

- U.S. Air Force, Installation Force Protection Guide: (Contains information on installation planning, engineering design, and construction techniques that will preclude or minimize the effect of a terrorist attack).

- Technical Manuals/Air Force Manual series TM 5-853/AFMAN) 32-1071, Security Engineering, 3 volume series: (Volumes 2 and 3 are "For Official Use Only [FOUO]" and are not available on the Army Corps of Engineers publications website. A copy of the manuals can be acquired via a standard publications account. The three volumes cover, Project Development, Concept Design, and Final Design respectively).

Figure 1 presents an annual summary of mean temperatures at Fort Hood. These temperatures illustrate one week for each month. Figure 2 presents mean monthly and annual temperature and precipitation at Fort Hood. Mean monthly temperatures range from 50 degrees Fahrenheit (°F) in December and January to 84°F in July and August. The average annual rainfall is approximately 31 inches. Most precipitation (more than 3 inches per month) occurs during the months of May through June and October with the least amount of rainfall occurring in January and July.

Figure 3 presents monthly distribution of cooling degree-days (CDD) and heating degree-days (HDD) for Fort Hood. The period from May through October accounts for almost 95% of total annual CDD. July and August have the highest number of CDD contributing to approximately 20% of total annual CDD each. The period from November through April accounts for almost 95% of total annual HDD. January and December have the highest number of HDD, contributing to approximately 25% of total HDD each.

Figures 4 through 7 present the frequency of different wind directions and wind combinations. The prevailing wind direction in the Fort Hood region from December through February is from the south, followed by a northerly wind. The wind strength from the south during these months is 15 to 24 knots 20% of the time and 6 to 14 knots 18% of the time. The strength of the northerly wind during these months is 15 to 24 knots 18% of the time (Figure 4).

The prevailing wind from March through May is from the south. The wind strength from the south during these months is 25 to 34 knots 25% of the time, 15 to 24 knots 24% of the time, and 6 to 14 knots 18% of the time (Figure 5).

In the Fort Hood region from June through August, the prevailing wind direction is from the south. During these months, the wind strength is 15 to 24 knots 33% of the time, and 6 to 14 knots 28% of the time (Figure 6).

September through November, the prevailing wind direction is from the south followed by a northerly wind. From the south during these months, the wind is 15 to 24 knots 25% of the time and 6 to 14 knots 22% of the time. From the north during these same months, the wind is 6 to 14 knots 11% of the time. For a complete detail of all wind speeds, including the percent of calm winds, please refer to Figures 4 through 7.

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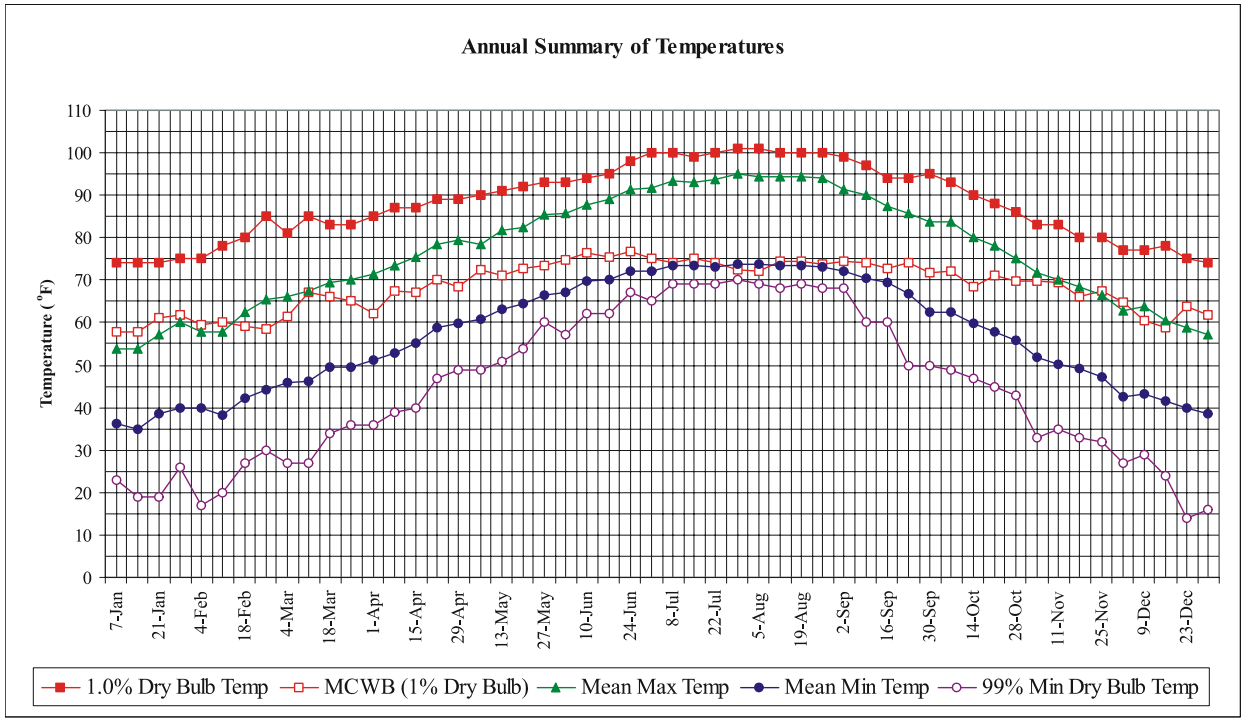

Figure 1 Annual Summary of Temperatures for Foot Hood

Note:

- 1% Dry Bulb Temp is the dry bulb temperature that is exceeded 1% of the time during that calendar week.
- MCWB (1% Dry Bulb) is the mean of wet bulb temperatures coincident with 1% dry bulb temperatures during the same week.
- Mean Max Temp is the daily maximum dry bulb temperature, averaged by week over the POR.
- Mean Min Temp is the daily minimum dry bulb temperature, averaged by week over the POR.
- 99% Min Dry Bulb Temp is the daily dry bulb temperature that is at or above this value 99% of the time, or below this value 1% of the time.

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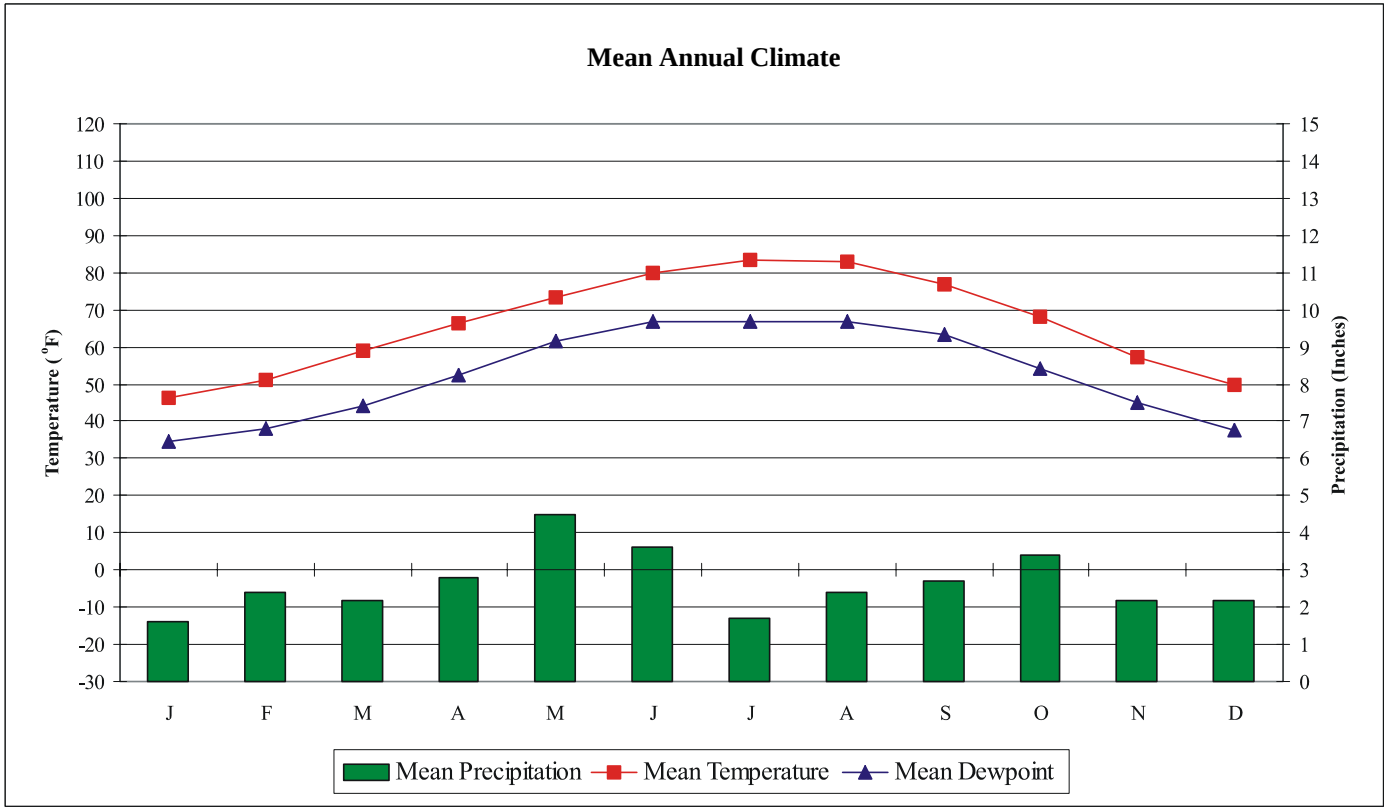

Figure 2 Mean Monthly and Annual Temperature and Precipitation at Fort Hood

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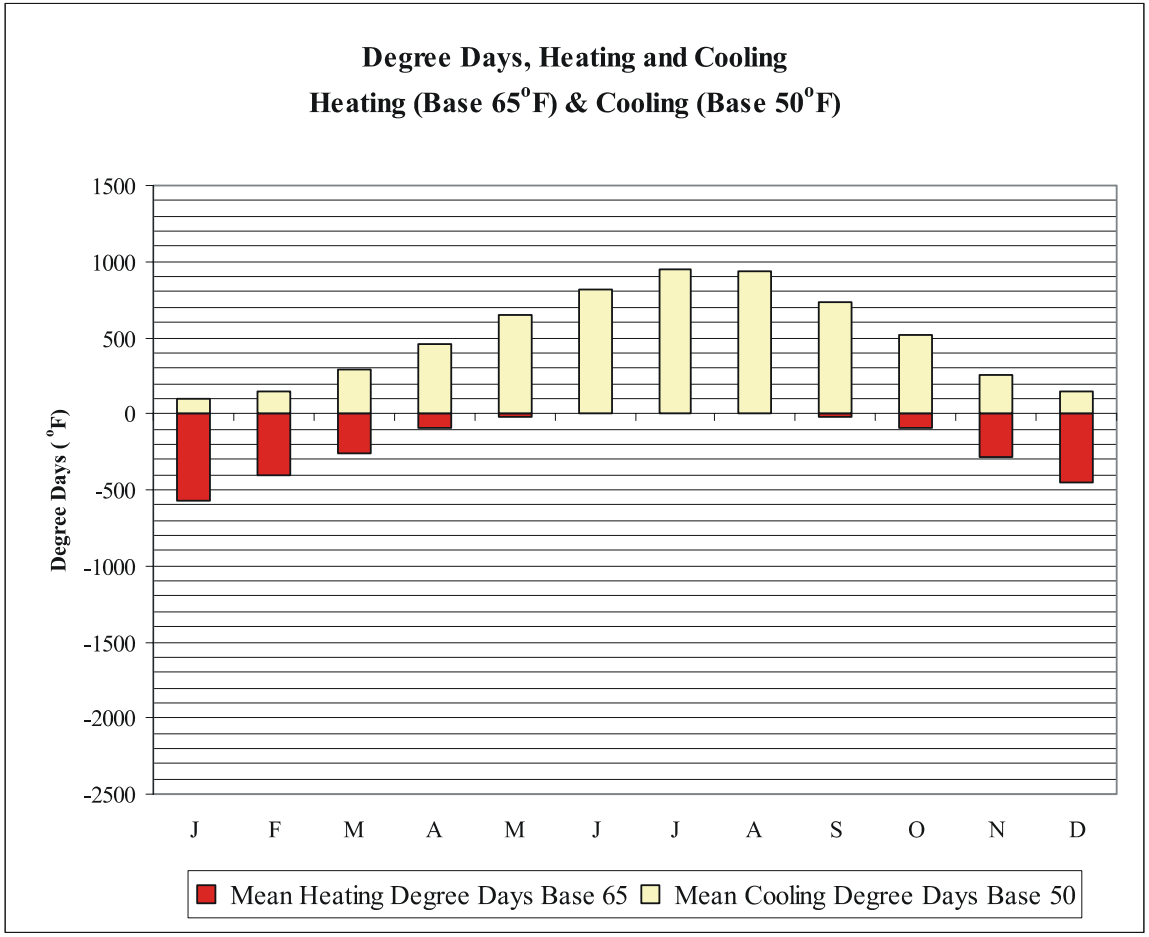
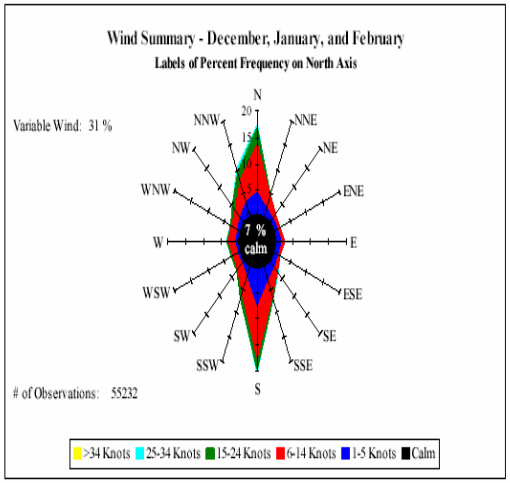
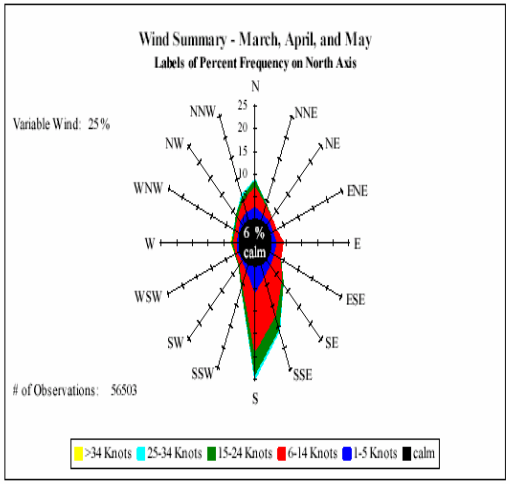


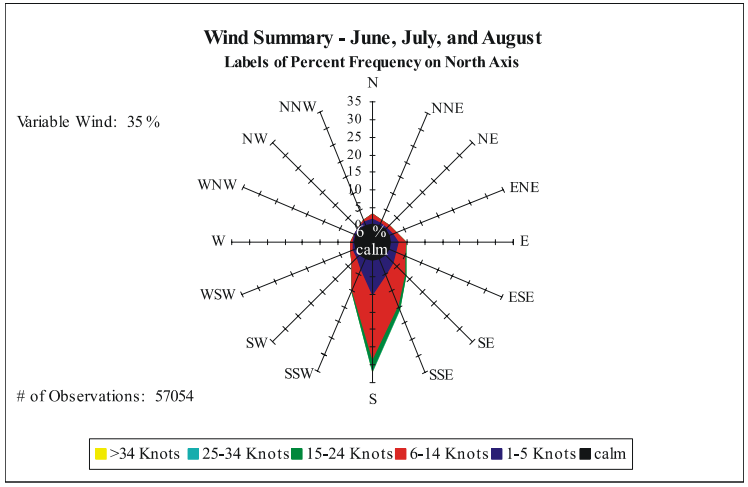
Figure 3 Monthly Distribution of Cooling Degree-Days (CDD) and Heating Degree-Days for Fort Hood

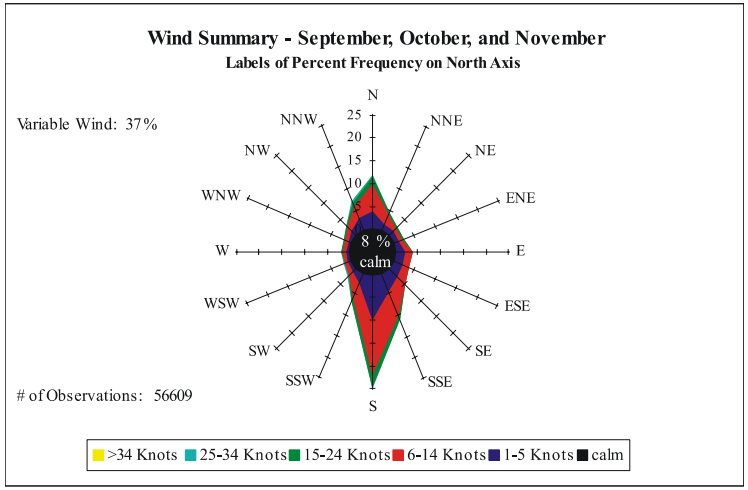




FORT HOOD/GRAY AAF TX (Page 17 of 18)

Figures 4 and 5 Frequency of Different Wind Direction and Wind Combinations (December through May)





Figures 6 and 7 Frequency of Different Wind Direction and Wind Combinations (June through November)