CHAPTER 3

SITE PLANNING AND DESIGN CRITERIA

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1. DESIGN TEAM. The planning and design processes shall be the responsibility of an interdisciplinary team of design professionals, ER 1110-1-8152 (reference 3-1). This multi-professional approach to the planning process helps assure that all aspects of the man-made and natural characteristics of the area being planned are properly and thoroughly considered, ER 1110-345-100 (reference 3-2). Plans are prepared that provide a comprehensive solution to the program requirements addressing environmental assessment of actions, design quality, and economic efficiency. Identify the interdisciplinary team membership at the beginning of the planning process so that its expertise can be applied from the outset. The membership of the team and the team leader shall be determined by the functional requirements of the project. There are four major components of a planning and design team: architecture, landscape architecture, land planning, and engineering. Other professionals such as civil, electrical, environmental, mechanical and structural engineers; hydrologists; geologists; and historical or archaeological preservationists may be included in the planning process as warranted by specific conditions. Involve the customer and users throughout the process. User input is critical to the success and acceptance of the plan.

2. AREA DEVELOPMENT PLAN (ADP).

a. General. The ADP is a process that is utilized to prepare a planning framework for areas that consist of complex or incompatible functions; or multiple functions requiring large areas of land and impact circulation and utilities. It may include a number of individual buildings or activities with common elements associated by function such as administration facilities or barracks facilities, or facilities that differ in use but are associated by proximity, such as a battalion area. The ADP is described as providing facility planning at the small area or sub-area level that falls between master planning for an entire installation and site planning for individual buildings. It provides for the definition of program requirements by coordinating the location of buildings, vehicular and pedestrian circulation, parking, open space and other activities or facilities within the area. The end result of the process is a plan both in written and graphic format. It describes the planning process; presents an efficient, economic and functional plan; and provides direction for implementation of the plan. The process utilizes urban planning and design principles to define land use and integrates functional requirements into compatible arrangements within the area. The installation real property master plan shall define the area for the programmed project scope. The selection of area boundaries needs to be determined before the process can begin. The ADP process is designed to occur in a series of steps or actions that result in an Area Development Plan with graphic illustration of all of the functions and elements proposed to occur within the area. Graphics are of primary importance throughout the plan to communicate the design intent and planning principles that are proposed. The final plans, text, and graphics provide a framework that defines an efficient, compatible, functional, and cost effective area. It includes details or sketches to illustrate land use, circulation and utilities.

b. Existing Conditions. Identification of existing conditions includes defining the goals and objectives; verifying the program requirements; developing functional relationships; defining spatial arrangements; providing an area analysis; and accomplishing a site visit. The installation real property master plan, Installation Design Guide and special studies are to be used.

(1) Goals and Objectives. The first step in the area planning process is to define project goals and objectives and installation development goals. Goals are general, while objectives define specific actions to achieve the goals. Goals and objectives are derived from the user mission and installation real property master plan. Review these documents to determine project guidelines to meet the mission. Determine the user's specific needs to include the following: functional requirements; efficiency; safety; environmental; economy of design and construction; sustainable design; and quality of life. The defined goals and objectives become guidelines for the area planning process.

(2) Facility and Land Area Requirements. The program requirements are reviewed to determine true project scope. Functional relationships and spatial arrangement charts and diagrams are developed to establish a functional, compatible, cost effective and efficient layout. The land area requirements include the building footprint; vehicular circulation; staff and visitor parking; delivery and service zones; emergency vehicle access; pedestrian circulation; surface water management; utility corridors; landscape design and open space; and hazard clear zones.

(a) Functional Relationships. The project requirements are used to determine the functional relationships of the proposed facilities. This process consists of analyzing the interactions between facilities and activities to determine compatibility and direct relationships.

(b) Functional Relationship Diagrams. The desired functional relationships are defined graphically through the use of diagrams. The diagrams organize the facilities into the best locations in relation to each other, irrespective of area considerations. These diagrams can be developed as matrices or as “bubble diagrams”.

1/ A bubble diagram presents each bubble connected with lines that illustrate the importance of the relationship to each other. The diagram clarifies appropriate connection or separation between functions. The bubble diagram approach is recommended because it provides a visual analysis of the desired relationships.

2/ A matrix compares facilities or activities numerically or symbolically. It is a chart with a legend.

(c) Spatial Arrangement. The spatial relationship of the functional requirements are determined by using bubble diagrams. The diagram for each function is drawn to scale to define the size of the activity. Spatial representations depict the facilities, activity areas, circulation, parking, open space and other programmed functions or elements. The selected spatial arrangement is determined by placing the functions in the above established relationship to each other. This procedure determines the adequacy of the program requirements to fit in the selected area.

(3) Map and Data Collection. The inventory of area data shall occur simultaneously with the definition of project requirements and their functional relationships. This inventory includes the collection of installation real property master plan maps, special studies and data about the environmental and manmade characteristics of the area and its environs. The data to be collected include the following.

(a) Area Base Map. The area base map provides the specific data about the area. Utilize the base map to develop subsequent area maps. Information to be provided on an area base map includes: existing structures; roadways, driveways, parking and walkways, topography, streams, water bodies, vegetation, fence lines, location of utilities, and other significant information. The area base map shall be prepared at a maximum scale 1:2000.

(b) Vicinity Map. The vicinity map includes the area development boundary and the surrounding areas. Coverage and detail in this map shall vary depending upon the size and complexity of the area. The vicinity map includes much of the same information as the area base map, but is prepared at a smaller scale.

(c) Location Map. The location map shows the area development in a regional context. Draw the map at a very small scale to show the relationship of the site to the region. This would include the installation boundaries and major roads, railroads, airfields and major natural features.

(d) Other Maps. Aerial photographs, US Soil Conservation Service (USSCS) soil surveys, and US Geographical Service (USGS) topographic surveys provide data about the area.

(e) Data Collection. Data to be collected falls into three broad categories corresponding to the three environments in which people live and work: the natural environment, the built environment, and the socio-cultural environment. Data to be collected varies for each project. Required data to be collected includes the following.

1/ Background data such as the installation real property master plan, Installation Design Guide, and special studies.

2/ Environmental features such as topography, hydrology (wetlands, ground water, surface water, drainage ways, etc.) and soils.

3/ Tree surveys and the street tree program to include the location, common and botanical name, size and condition of all trees.

4/ Physical features such as existing buildings, vehicular circulation, parking, pedestrian circulation, and fences.

5/ Significant architectural or historical features.

6/ Significant climatic conditions such as wind, sun and precipitation.

7/ Significant views to be enhanced or obscured.

8/ Sustainable design issues and recommendations.

9/ Real estate easements and leases.

10/ Proposed modifications or changes that impact the area.

11/ Standard Designs. The Army provides standard designs for many facilities with a layout that needs to be site adapted. These designs are definitive designs serving as guides requiring site adaptation and do not refer to real geography.

(4) Site Visit. A site visit of the area is an essential part of data collection. No other task provides as much useful information for understanding overall area impacts. It provides a visual impressions assessment of features such as architectural character, significant views, landscape character, and prominent land features. The site visit provides the opportunity to accomplish the following.

(a) Review and verify existing information.

(b) Evaluate the compatibility of existing on-site and off-site conditions.

(c) Reveal any unknown or unrecorded conditions and factors.

(d) Evaluate sustainable design issues and recommendations.

(e) Evaluate the area design qualities and visual impressions.

c. Area Analysis. The area analysis is the product of the site visit and the evaluation is graphically portrayed as the opportunities and constraints map for the area. It is sketched on the area topographic map. It is important to understand the impacts the programmed functions have on the area and the relationship these functions have on

one another. Document a thorough analyses. The analyses include overlaying the topographic map with transparencies of soils, hydrology and vegetation maps to define the natural conditions of the area. Show all manmade functions or elements such as buildings, roadways, and utility lines. These maps define the area development opportunities and constraints. Evaluate the following conditions, factors, or elements.

(1) Off-Site Conditions. An area development is influenced by factors adjacent to the area. Consider both existing conditions and future development. Evaluate the following conditions, factors or elements to determine the potential impacts with the area development.

(a) Land Use. Record surrounding land use and verify the land use category.

(b) Transportation. Locate and evaluate all existing and proposed vehicular transportation systems to determine their hierarchy and current capacity. Examine primary and secondary roadways to determine access points, traffic loads and vehicular safety requirements. Record all parking areas. Identify bus routes and loading zones. A Site Traffic Impact Study may be prepared.

(c) Utilities. Locate all primary utilities and utility lines documenting the size of the lines; capacities of generation; and current and projected utilization. The utilities include the following: water system; sanitary sewer system; storm drainage system and drainage basin; electrical, gas and steam systems; telephone system; and other types of communication systems or specialized utility systems.

(d) Environmental Conditions and Hazards. Record all areas or conditions of environmental concern near the area. Further guidance for assessing environmental conditions is provided in AR 200-2 (reference 3-3). The assessment includes the following: storm drainage patterns indicating watershed boundaries and the direction of flow; storm water management areas; flood plains; wetland areas; wildlife habitats (especially for threatened and endangered species); buried tanks, Installation Restoration Program (IRP); and other hazards.

(e) Historic, Cultural and/or Archeological Resources. Identify all structures or sites that have been defined as historically, culturally or archeologically significant in the vicinity, Chapter 16.

(f) Safety Hazards. Identify all requirements and distances necessary for safety such as fire protection clearances discussed in Chapter 9; flood control; airfield and helipad clear zones discussed in Appendix K; protective design discussed in Chapter 10; and explosive safety clear zones.

(g) Installation Physical Security. Coordinate the physical security requirements with the Installation Physical Security Plan. Determine existing or potential threat, high risk targets, and current vulnerabilities to deter attack by consulting with the Provost Marshall, TM 5-853-2 (reference 3-4) and TM 5-853-3 (reference 3-5) and Chapter 10.

(h) Sources of Air, Noise and Light Pollution. Identify immediate or point sources of pollution and evaluate their impact upon the site. Information may be found in the environmental impact assessments for the installation. Indicate the need and potential for achieving mitigation. Evaluate non-point sources of pollution entering or leaving the area.

(i) Visual Enclosure. The area's view shed (area of visual enclosure) extends beyond the area boundaries. The degree to which the surrounding environment contributes to the area's sense of enclosure or openness, may create desirable or undesirable views from the area. There may need to be buffers for the area's own visual condition.

(2) On-Site Conditions. Record all factors within the area boundary. Consider both existing conditions and future development. Examine the following conditions, factors or elements to determine the impacts within the

area.

(a) Geology. Evaluate geological conditions above and below the ground surface for determining the type of rock and its geologic formation.

(b) Topography. Define existing elevations, high points, low points, and slopes. Slopes are usually described by their percent (%) grade and placed in appropriate ranges (e.g., 0-5%, 5-10%, 10-20%, etc.).

(c) Hydrology. A hydrology assessment provides information on surface and subsurface water movement. This information can be utilized to prevent flooding, erosion, and pollution of surface and groundwater and to promote groundwater recharge, habitat development and recreational use.

1/ Subsurface Hydrology. Subsurface hydrology concerns the storage and movement of water beneath the soil surface. Groundwater moves through the soil and through aquifers. Because aquifers are potential sources of potable water, federal, state and local agencies may regulate the quantity and quality of water allowed to infiltrate the ground surface. When the area is in a groundwater recharge area, there may be restrictions upon the amount of impermeable surface to be implemented and upon the water quality allowed for infiltration.

2/ Surface Hydrology. Record existing surface water bodies such as rivers, lakes, ponds, streams and springs. Record drainage patterns, flood plains, impermeable surfaces (pavements and rooftops) and other conditions effecting the movement of surface water. Depict significant information graphically.

(d) Soils. Record soils types and locations and depict graphically. Define the development potential of each type of soil.

(e) Climate. Define a complete climatic evaluation of the area. Climatic conditions effect such planning concerns as building location and orientation, pedestrian circulation, and vegetation. Obtain and evaluate the following information: average monthly temperature range; quantity, frequency and type of precipitation; midwinter and midsummer sunrise and sunset orientation and angle; and prevailing wind direction throughout the year.

(f) Vegetation. Review the installation real property master plan tree plan and street tree program. Graphically show the location of all existing trees. Locate the trees by survey and identify by common and botanical name, size and condition. Identification of local plant associations provide information on the types of tree and under story plant material thriving in the area. Utilize this information to apply landscape design principles when the area is developed.

(g) Wildlife Habitat. Identify natural wildlife habitats within the development area. Threatened and endangered species habitat requires protection.

(h) Archeological, Cultural and Historic Resources. Identify structures or sites that have been defined as historically, culturally or archeologically significant, Chapter 16. Those structures or areas requiring preservation may have a significant impact on the area development.

(3) Visual Impressions Survey. Accomplish an evaluation of the visual character of the area. This evaluation is made during the site visit and attempts to capture the feeling or essence of the area. Aspects of the assessment including the following.

(a) General geologic, topographic and vegetative character.

(b) Visual character of the area including view boundaries, good and poor site-specific views and

their potential for enhancement or mitigation, and special visual features defining the character of the area or make a strong visual impact. Examples of visual features include: water bodies, mature tree specimens, rock outcrops, and sunlight or shadow patterns.

(c) Sensory information such as odor, noise, or open or confined spaces.

(d) Microclimate conditions, such as warm or cold areas.

d. Opportunities and Constraints. The evaluations made in the area analysis are recorded on the topographic map to summarize the area opportunities and constraints. The opportunities and constraints map is used to verify that the area can accommodate the program requirements. The area features are interpreted as either opportunities to be explored and enhanced; or constraints to be avoided or mitigated. The map defines the following.

(1) Natural features to be preserved for environmental protection.

(2) Natural features to be conserved.

(3) Natural features that impact construction.

(4) Climatic conditions to include temperature, solar radiation, wind, and precipitation.

(5) Historic preservation of existing structures or other landmarks as discussed in Chapter 16.

(6) Future development programmed for existing structures or other landmarks.

(7) Existing structures or other features that have a negative impact on the area.

(8) Vehicular and pedestrian circulation points of conflict and opportunity

(9) All utilities that serve the area.

(10) Required buffers, setbacks, easements and right-of-ways.

(11) Physical security and safety clear zones.

(12) Projects effecting the use of airspace.

(13) Desirable visual impact to be enhanced and undesirable visual impacts to be screened.

(14) Significant vegetation, especially trees and shrubs.

e. Limited or Confined Area. A key requirement for area verification is the determination that current user requirements obtained from the program analysis can be accommodated within the area defined. When the area is limited or confined and will not accommodate the project, the installation shall provide a different area or a revised project scope. Coordinate the scope with the user to redefine the facility to fit the area. Some methods involve reducing the functional requirements, purchasing more land or further simplifying the design. Use the area analysis to determine the appropriate requirements for the limited or confined site and record that information in the opportunities and constraints map.

f. Concept Plan. The next step in the process is the preparation of a plan. Plan preparation begins with the

development of alternative plans. Alternative plans are sketch plans that provide organization of the spatial arrangements. The alternative plans are utilized to study all possible arrangements for achieving an ideal area plan that meets the desired functional relationships and the goals and objectives. Develop three different alternative plans. The plans include the following information: delineate the area boundary; vehicular circulation to include service access; delineate existing and proposed development sites; pedestrian circulation; and significant features and proposed landmarks.

(1) Evaluation. Upon completion of the concept plan, the alternatives shall be evaluated and a preferred plan selected.

(a) Matrix. The evaluation process requires the preparation of an evaluation matrix that lists all of the pros and cons that were defined during preparation of the alterative plans. The matrix aides the process to compare conflicting project demands to include site constraints, ideal solutions, costs, and future expansion. Evaluate the ability of the solution to meet quality design; project requirements; IDG; and the goals and objectives. Each alternative shall include notations of challenges and benefits. Keep a record of the design strategies that were employed during the design decision making process. This information is utilized in developing an evaluation matrix for the final assessment of the alternatives. Information can be recorded on each plan or as a separate document.

(b) Design Team. The plans and their design strategies shall be reviewed by the design team, customer and user. Evaluate the planning matrix, the assets and liabilities of each alternative plan and the recommended preferred alternative. The preferred plan shall be the one that best addresses the preservation of the environment and natural resources; provides the best functional and spatial relationships; and meets the project goals and objectives.

(2) Approved Concept Plan. There shall be a consensus for the preferred alternative plan. The preferred plan may be one of the selected alternatives or a composite of the most desirable aspects of several or all of the alternatives. The review team prepares a definitive analysis of the assets and liabilities that led to the selection. The preferred plan shall be presented and approved by the Installation Commander and the Installation Planning Board as the final step in the selection process.

g. Area Development Plan. Development of the final plan from the approved concept plan includes a preliminary (sketch) area plan, location plan; final area plan; and a report defining the process and elements of the plan.

(1) Preliminary (Sketch) Area Plan. The preliminary area plan shall be prepared as a sketch plan that includes all of the existing and proposed facilities and other activities located within the land areas defined. These include, but are not limited to proposed roadways, buildings, driveways, parking, open space, and future development areas. The preliminary plan shall be presented for review and comment before the final plan is prepared and includes the following elements.

(a) Building envelopes or footprints.

(b) Setbacks to include building, circulation, environmental and safety clear zones.

(c) Existing and proposed vehicular circulation and parking to accurately portray the total number of vehicles accommodated.

(d) Existing and proposed pedestrian circulation, congregation plazas, and street furnishings.

(e) Landscape elements to include existing and proposed trees, shrub massing, and areas of trees

to be preserved.

(f) Open space, athletic fields, and parade grounds.

(g) Service areas to include dumpster pads with screening.

(h) Future expansion.

(i) Utility corridors to include routes for gas, water, sewer, storm drain lines, telephone, electric, and steam, etc.

(2) Location Plan. The location plan can be included as an inset on the final plan sheet or as a separate drawing. The purpose of the location plan is to illustrate the location of the development area in relation to the surrounding activities. Include roadways, driveways, pedestrian walkways, utilities, drainage ways and other impacts outside the area. Prepare the location plan on a standard sheet, to scale, with a north arrow. It may be prepared in color or in black and white.

(3) Final Area Plan. The final area plan shall be prepared from the approved preliminary (sketch) plan.

(4) Report. The report includes a brief narrative of the process that provides an overview of the analysis and results. Define the entire process to include all of the steps taken from the statement of the goals and objectives through selection of the concept preferred plan and final plan. Include the following in the report.

(a) Assessed impact on the real property master plan goals and objectives.

(b) Proposed projects.

(c) Recommended transportation improvements.

(d) Recommended utility upgrades and infrastructure improvements.

(e) Architectural compatibility guidelines and recommendations.

(f) Landscape design recommendations and guidelines, TM 5-803-13 (reference 3-6).

(g) Sustainable design recommendations and guidelines.

(h) Site design recommendations and guidelines TM 5-803-14 (reference 3-7).

(i) Copies of all matrices and tables.

(j) Sketches. More detailed sketches may be included in the report to focus on particular problems or to illustrate the design thought process. The sketches may include the following.

1/ Building massing, view enhancement/protection strategies.

2/ Proposed roadway and driveway cross sections used to develop the plan.

3/ Landscape planting design and plant material details, TM 5-803-13 (reference 3-6).

4/ Sustainable design and other design detailing such as material and color palettes for

buildings, pavements, site furnishings, etc.

5/ Signage, lighting or other street furniture recommendations.

3. INSTALLATION DESIGN GUIDE (IDG).

a. General. Army installations shall develop their own guidelines to promote a quality, harmonious and visually compatible character that provides visual order, interest, safety, and life-cycle economy of maintenance. Formulate the design criteria for the installation to be responsive to these objectives. Develop criteria for each function or element comprising the visual environment of the installation to include the following.

(1) Architectural design principles defined as a compatibility guide for the desired architectural character, color palette, massing, materials, and scale of building design.

(2) Landscape design principles defined for the desired landscape character, massing, scale, plant materials, and details appropriate to the installation and its climate.

(3) Site planning and design principles defined for the desired vehicular and pedestrian circulation, parking, and utilities. Provide guidelines for the compatible signage, site furnishings, and exterior lighting.

(4) Guidelines defined for environmental requirements; energy conservation; sustainable design; traffic safety; low maintenance; and economic life-cycle maintenance capability.

b. Design Principles. The design principles conform to the site planning, landscape design and sustainable design principles stated in TM 5-803-5 (reference 3-8), TM 5-803-13 (reference 3-6) and TM 5-803-14 (reference 3-7). Sustainable design principles shall be discussed.

c. Army Communities of Excellence (ACOE) Program. The purpose of the program is to provide excellent places to live, train, and work for soldiers, civilians, and families, and to provide Army personnel with the best possible customer services. One of the key documents that addresses excellence of installation facilities is the IDG, required as part of the ACOE program, DA PAM 600-45 (reference 3-9).

d. Design Guide Outline. The IDG is a component of the installation real property master plan, AR 210-20 (reference 3-10). The maps associated with the narrative are derived from the installation existing conditions maps and are used as the baseline for planning overlays for the IDG. The IDG consists of an executive summary, introduction, design guidelines, the visual zones and themes, and an implementation plan. An outline of the complete IDG narrative is provided below, and descriptions of each part of the plan format follow.

(1) Executive Summary.

(2) Background.

(a) Acknowledgments.

(b) Procedures for Using the Document.

(c) Coordination with the Installation Real Property Master Plan.

(d) Procedures for Updating the Document.

(e) Table of Contents.

(3) Introduction.

(a) Goals and Objectives.

(b) Army Needs and Policies.

(c) Constraints and Opportunities.

(d) Existing Conditions.

1/ Regional and Local Character.

2/ Historical Review of Site Development.

3/ Visual Survey.

4/ Analysis of Existing Visual Character.

(4) Design Guidelines.

(5) The Visual Environment.

(a) General Description.

1/ Zones.

2/ Elements.

3/ Buildings.

4/ Interiors.

(b) Proposed Theme and Concept.

1/ Theme.

2/ Observations.

3/ Proposals.

(6) Implementation Plan.

(a) Priority Project List.

(b) Problems.

(c) Solutions.

(d) Cost Estimate.

e. Requirements.

(1) Contents. The IDG contains an executive summary and enough supplemental information, including details, matrixes, photographs, schedules and sketches, throughout the text to clearly depict the recommended visual zones and themes of the installation. The IDG synthesizes all of the functions or elements effecting the visual impressions of the installation and provide recommendations. Write the document in a concise style and provide it as a separate document for use by Installation Commanders, installation staff, and others interested in or effected by activities on the installation.

(2) Background. Include in this section acknowledgments, procedures for using the plan, coordination of the plan with the installation real property master plan, procedures for updating, and a table of contents.

(3) Introduction. This section sets the goals and objectives of the IDG, establish the needs and policies, and identify the constraints and opportunities available to the planner.

(a) Installation Profile. This section documents the visual profile of the installation. Identify the regional and local character of the architectural and natural elements. Describe geometric shapes and forms in terms of historical influences as discussed in Chapter 16; protective design level of threat, as discussed in Chapter 10; operational efficiency; command and control.

(b) Visual Impressions Survey.

1/ Windshield Survey. Perform a windshield survey of the zones on the installation and Evaluate the visual quality and the dominant positive and negative visual impressions of the installation. Describe the impressions in terms of the land features, open spaces, and distinctive character. Conduct this survey as if an individual were seeing the installation for the first time. Record the frequency of encountered functions or elements and their quantitative impressions. Describe the commonly observed negative impressions. Describe the existing visual character, major functional use, and types of facilities in each zone. Evaluate the daytime and nighttime visual quality of the installation. Document the results of the visual survey in a report with supporting graphics and illustrations.

2/ Questionnaires and Interviews. Survey installation personnel to determine the visual elements that are significant to them.

3/ Survey Building Interiors. Assess the building interiors visual character and motif in terms of the good or bad impact on the user.

(c) Functional Analysis of the Survey. Organize the impressions of the installation and assess the functional relationships of the visual elements to determine the visual character and unifying motif of each zone. Focus the analysis as the sum of all of its visual elements. Determine the degree of dependence, physical connections, and the relative importance of the visual elements to each other. The purpose of the functional analysis is to identify opportunities and constraints.

1/ Areas of Concern. The goal of the IDG is to provide guidance for the creation of an installation environment that is harmonious, compatible and visually pleasing. To achieve this goal, areas that create a negative impression shall be identified, and a prioritized plan created for the elimination of negative features. Elimination of visual clutter significantly improves the visual character of areas, buildings, and interiors. Determine the elements to be retained or enhanced, and the elements to be removed.

2/ Visual Impressions Plan. Develop a Visual Impressions Plan by graphically recording the results of the visual survey and the functional analysis on site maps.

(4) Design Guidelines. Establish design principles and definitions that incorporate the specific and unique character of the installation, TM 5-803-5 (reference 3-8), TM 5-803-13 (reference 3-6) and TM 5-803-14 (reference 3-7). Develop design guidelines that are responsive to the approved visual character, and the goals and objectives for each of the visual elements. The purpose of the guidelines is to provide design recommendations and standards that define color, materials, style, signage, and other aspects of design for all visual elements that have been surveyed and analyzed. Sustainable design issues and recommendations shall be provided. These guidelines promote design unity and harmony, and reinforce the visual character of the installation. The design guidelines provide guidance for new construction, renovation, and maintenance and repair projects. The guidelines respond to the unique site conditions of the installation.

(5) The Visual Environment.

(a) Zones. Analyze the installation to establish the parameters for dividing the installation into zones for exterior design guidelines. Base the zones on the major functional use of the area. Describe the boundaries that separate zones and the relationships of the zones to each other.

(b) Visual Elements. The visual elements that exist on the installation are determined and may include the following.

1/ Installation Boundaries. Describe the character around the periphery of the installation in terms of the physical factors and the views that shape the overall public image. Describe the character of the visual edges that define the functional areas within the installation.

2/ Entrances and Gates. Describe in terms of their initial impressions entrances and gates that provide access onto the installation; serve as checkpoints; security control points; and visitor orientation.

3/ Circulation System. Describe the hierarchy of flow; convenience; and the efficiency of the road network to serve the functional areas. Describe the visual reinforcement and orientation of the hierarchy of the road network. Describe the separation of the vehicular and pedestrian circulation in terms of traffic safety. Describe the channelization and compatibility of organizational and privately-owned vehicular traffic using the same routes.

4/ Street Trees. Describe the ability of the street tree system to soften, complement, and define the road hierarchy, and improve the overall visual quality of the installation.

5/ Vegetation. Describe the character of the existing vegetation in terms of screens, energy conservation, hardiness, ease of maintenance, and defining open space.

6/ Views and Vistas. Describe the visual extensions through the open spaces that provide a sense of orientation, relief, and enjoyment.

7/ Open Spaces. Describe the major open land areas in terms of the importance for retaining and preserving the areas.

8/ Activity Nodes. Describe the character of the areas that generate and collect people, and the adequacy of the space for the number of people using the area, as well as the separation of vehicles and pedestrians.

9/ Buildings and Structures. Describe the design character, siting, and visual image of buildings and their interiors. Address structures including walls, lighting fixtures and other items of site furnishings. Describe the open space between buildings and structures in terms of scale; fire protection clearances as discussed in

Chapter 9; and protective design clearances as discussed in Chapter 10. Document the historical character of buildings, structures, and areas as discussed in Chapter 16.

10/ Signage. Develop a coordinated installation signage plan; addressing both exterior and interior signs to facilitate safe circulation and provide useful information. Carefully consider the content and quantity of signs to avoid unnecessary signs. An approved installation signage plan applies to all activities on an installation.

11/ Landmarks. Describe those prominent features on an installation that help to orient people.

12/ Utility Corridors. Describe the character of the utility lines and utility service areas.

13/ Other Elements. Describe the character of other unique or significant elements, such as topography, installation physical security, wildlife habitats, and climate that effects the image of the installation.

(c) Proposed Theme and Concept. Recommend the visual character for each zone on an installation based on the visual survey, interviews, and the functional analysis. Describe the intended image. Define the visual character into positive and negative impressions. The recommended visual character is the basic unifying motif that reinforces the existing character and future improvements framework.

(6) Implementation Plan. Prepare an implementation plan for the IDG. Include in the implementation plan a project list that establishes priorities, cost estimates, project documentation, and funding recommendations.

(a) Project List Development. Recommend projects that accomplish the stated IDG goals and objectives. The projects may consist of the enhancement of a single visual element or improvement of an area that includes all of its composite elements. Develop the projects taking into consideration all factors regardless of the source of funds.

(b) Project Priorities. Prioritize the projects in accordance with the goals and objectives of the IDG. Guidelines for prioritizing the projects include, but are not limited to: aesthetic improvement, daytime and nighttime image enhancement, funding, improved functional efficiency, morale enhancement, and safety.

(c) Cost Estimates. Develop a cost estimate for each project.

(d) Funding. Recommend a practical funding source that facilitates a realistic implementation of the IDG in accordance with the installation's funding authority using OM&A funds, or other funds as available. Investigate alternative funding sources and include them in the recommendations.

f. Format.

(1) Report. Prepare the IDG on 213 mm x 275 mm (8-1/2 in x 11 in) paper in a loose-leaf document suitable for adding amendments and revisions. Retain the document in word processing format for ease of updating. The IDG cover indicates the name of the installation, location, date of preparation, logo, and the name of the preparer.

(2) Graphics. Graphics may include charts, sketches, and tables. They may be prepared, integrated, and numbered consecutively with the text on 213 mm x 275 mm (8-1/2 in x 11 in) paper or foldouts. The narrative may contain sketches that delineate the preferred conceptual development and proposed guidelines. Any technique used shall be easy to create and reproduce. Graphics used to show conceptual development shall be diagrammatic to show broad planning factors.

(3) Maps. When required, prepare full-size drawings. These drawings may be reduced for inclusion into

the loose-leaf document.

4. SITE PLAN.

a. General. Site planning and design is described as further defining the functional layout for specific buildings or functions programmed for the site. The site planning process utilizes site planning principles and is a process that is sequential from beginning to end. It provides for the definition of program requirements in coordination with the location of buildings, vehicular and pedestrian circulation, parking, open space and other activities or facilities within the site boundaries. The end result of the process is a planned layout both in written and graphic format that describes the planning process; and presents an efficient, economic and functional layout. The installation real property master plan defines the site for the programmed project scope. The selection of site boundaries will need to be determined before the process can begin. Graphics are of primary importance to communicate the design intent and planning principles that are proposed. The plans, text, and graphics provide a framework that defines an efficient, functional and cost effective layout. The final site plan is a graphic illustration of all of the functions or elements proposed to occur within the site boundaries. The plan includes details or sketches to illustrate functional relationships, circulation, and utilities.

b. Existing Conditions. Identification of existing conditions includes defining the goals and objectives; verifying the program requirements; developing functional relationships; defining spatial arrangements; providing a site analysis; and accomplishing a site visit. The installation real property master plan, Installation Design Guide, and special studies are to be used.

(1) Goals and Objectives. The first step in the site planning process is to define project goals and objectives and installation development. Goals are general, while the objectives define specific actions to achieve the goals. Goals and objectives are derived from the user mission and installation real property master plan. Review these documents to determine project guidelines to meet the mission. Determine the user's specific needs to include the following: functional requirements; efficiency; safety; environmental; economy of design and construction; sustainable design; and quality of life. The defined goals and objectives become guidelines for the site planning process.

(2) Facility and Land Area Requirements. The program requirements are reviewed to determine true project scope. Functional relationships and spatial arrangement charts and diagrams are developed to establish a functional, compatible, cost effective and efficient layout. The land area requirements include the building footprint; vehicular circulation; staff and visitor parking; delivery and service zones; emergency vehicle access; pedestrian circulation; surface water management; utility corridors; landscape design and open space; and hazard clear zones.

(3) Functional Relationships. The project requirements are used to determine the functional relationships of the proposed facilities. This process consists of analyzing the interactions between facilities and activities to determine compatibility and direct relationships.

(a) Functional Relationship Diagrams. The desired functional relationships are defined graphically through the use of diagrams. The diagrams organize the facilities into the best locations in relation to each other, irrespective of site considerations. These diagrams can be developed as matrices or as “bubble diagrams”.

1/ A bubble diagram presents each bubble connected with lines illustrating the importance of the relationship to each other. The diagram clarifies appropriate connection or separation between functions. The bubble diagram approach is recommended because it provides a visual analysis of the desired relationships.

2/ A matrix compares facilities or activities numerically or symbolically. It is a chart with a legend.

(b) Spatial Arrangement. The spatial relationship of the functional requirements are determined by using bubble diagrams. The diagram for each function is drawn to scale to define the size of the activity. Spatial representations depict the facilities; functions and activity areas; circulation; parking; and open space. The selected spatial arrangement is determined by placing the functions in the above established relationship to each other. This procedure determines the adequacy of the program requirements to fit in the selected site.

(4) Base Map and Data Collection. The inventory of the site data occurs simultaneously with the definition of project requirements and their functional relationships. This inventory includes the collection of installation real property master plan maps, special studies and data about the environmental and manmade characteristics of the site and its environs. Utilize existing installation real property master plan maps, area development plans, special studies and other data. The data to be collected include the following.

(a) Site Base Map. The site base map provides all the site specific data. Utilize the base map for developing subsequent site maps. Information to be provided on a site base map include: existing structures; vehicular circulation; parking; pedestrian circulation; topography; streams; water bodies; vegetation; fence lines; and utilities. The site base map shall be prepared at a maximum scale 1:1000. This scale varies depending upon the size of the site. The base maps to be collected or prepared include the following.

(b) Site Map. Provide a map to include the topographic survey at 1 m intervals; and surveyed location of all existing structures; utilities; and significant features.

(c) Tree Survey Map. Perform a tree survey to record all trees with a diameter at breast height (DBH) of 100 mm (4 in) or greater with their location, common and botanical name, size and condition.

(d) Location Map. A location map is included to show the site and the vicinity. The location map includes much of the same information as the base map, but is prepared at a smaller scale. This map includes the site boundaries, primary facilities, major roadways and major natural features.

(e) Utilities Map. Existing and proposed utility locations are shown in the vicinity of the site by size and type.

(f) Transportation Map. Existing and proposed area transportation to include vehicular, aviation and railroads are shown. Provide existing and proposed carrying capacities; proposed improvements; and hierarchy or class of roadways, airfields and helipads, and track way.

(g) Other Maps. Aerial photographs, flood maps, USSCS soil surveys, and USGS topographic surveys can provide important data about the area.

(h) Data Collection. Data to be collected falls into three broad categories corresponding to the three environments in which people live and work: the natural environment, the built environment, and the socio-cultural environment. Site data includes the following.

1/ Background data such as the installation real property master plan, the Installation Design Guide, special studies, area development plans and/or concept plans and user information.

2/ Site design criteria and site planning information for all facility types. This information includes requirements for non-organizational - privately owned vehicle (POV); visitor parking; energy conservation model as discussed in Chapter 11; sustainable design; utility corridor, protective design as discussed in Chapter 10; and fire protection as discussed in Chapter 9.

3/ Standard Designs. The Army provides standard designs for many facilities including a layout plan that needs to be site adapted. These designs are definitive designs serving as guides requiring site adaptation and do not refer to real geography.

4/ Soil borings to determine the type and capacity of the soil to support the proposed facilities.

5/ Geology and hydrology analysis utilizing soil borings.

6/ Existing ecological features of the site.

7/ Significant climatic conditions such as wind, sun or other precipitation.

8/ Sustainable design issues and recommendations.

9/ Significant views to be enhanced or obscured.

10/ Significant architectural or historical features or other preservation requirements.

11/ Proposed improvements and other changes that impact the site.

(5) Site Visit. A site visit is essential part of data collection. No other task provides as much useful information for understanding overall site impacts. It provides a visual impressions assessment of features such as architectural character, significant views, landscape character, and prominent land features. The site visit provides the opportunity to observe the following.

(a) Review and verify existing information.

(b) Evaluate the compatibility of existing on-site and off-site conditions.

(c) Discover previously unknown or unrecorded conditions and factors.

(d) Evaluate the design qualities, sustainable design and visual qualities of the site.

c. Site Analysis. The site analysis is the product of the site visit and the evaluation is graphically portrayed as the opportunities and constraints map for the site. It is sketched on the site topographic map. It is important to understand the impacts the program functions or elements have on the area and the relationship these functions or elements have on one another. Document the analyses. Show the analyses by overlaying the topographic map with transparencies of soils, hydrology and vegetation maps to define the natural conditions of the site. Show all manmade functions or elements such as buildings, roadways, and utilities. These maps define the site development opportunities and constraints. Evaluate the following conditions, factors or elements.

(1) Off-Site Conditions. A site development is influenced by factors adjacent to the site. Consider both existing conditions and future development. Evaluate the following conditions, factors or elements to determine potential impacts with the site development Information concerning the surrounding environment. Obtain the following information for the site analysis.

(a) Land Use. Record surrounding land use and verify the land use category.

(b) Transportation.

1/ Vehicular Circulation. Prepare a Site Traffic Impact Study for the area, TM 5-803-14

(reference 3-7). Survey the adjacent roadways showing existing lanes, curb, drainage, and curb cuts. Existing hierarchy of roadways, carrying capacities, design vehicle, and traffic analysis of peak hour traffic. Provide future plans of all proposed new roadways or improvements that would impact the site.

2/ Airfield and Helipad. Existing and future plans of all proposed airfields and helipads to include improvements that would impact the site.

3/ Railroad. Existing and future plans of all proposed railroad track way to include improvements that would impact the site.

(c) Utilities. Surveyed location of all utilities in the immediate vicinity to the site including the size of the lines, capacities of generation, current and projected demand, and proposed expansion. The utilities to be included are: water system with locations of fire hydrants; sanitary sewer system; storm drainage system and drainage basin with invert elevations; electrical, gas and steam systems; telephone system; and other types of communication systems or specialized utility systems.

(d) Environmental Conditions. Further guidance on assessing environmental conditions is provided in AR 200-2 (reference 3-3). Storm drainage patterns indicating watershed boundaries and the direction of flow; storm water management areas; flood plains; wetlands; wildlife habitats; buried tanks; and historic, cultural and/or archeological resources to include discussing any regulations governing activities near them.

(e) Safety Hazards. Identify all requirements and distances necessary for safety such as fire protection clearances discussed in Chapter 9; flood control; airfield and helipad clear zones discussed in Appendix K; protective design clearances discussed in Chapter 10; and explosives safety clear zones.

(f) Installation Physical Security. Coordinate the physical security requirements with the Installation Physical Security Plan. Determine existing or potential threat, high probable risk targets, and current vulnerabilities to deter attack by consulting with the Provost Marshall; and TM 5-853-2 (reference 3-4), TM 5-853-3 (reference 3-5) and Chapter 10.

(g) Sources of Air, Noise and Light Pollution. Identify any immediate sources of air, noise and light pollution and evaluate their impact upon the site.

(h) Visual Enclosure. Record desirable or undesirable views from the site.

(i) Hazards and Nuisance Effects. Hazards and nuisance effects created by land uses adjacent to the project site impact the site selection and development. Examples of hazards and nuisance include: dust, noise, odors, explosives storage, and electromagnetic radiation or interference.

(2) On-Site Data. Record all factors within the site effecting development and evaluate them as part of the natural environment analysis, the built environment analysis, and the socio-cultural environment analysis. Examine the following conditions, factors or elements to evaluate potential impacts and connections within the site development.

(a) Provide a topographic map at a minimum 305 mm (1 ft) contour interval. More than any other site characteristic, topography will influence the design of a project. Plan the project to fit the topography, require a minimum of grading, and preserve the character of the site so as to produce a compatible, economical, and efficient composition.

(b) Surveyed location of all existing structures, paved and unpaved vehicular and pedestrian areas, fences, and utilities.

(c) Surveyed location of all abutting vehicular and pedestrian areas.

(d) Accurate soils identification for all areas of the site.

(e) Surveyed location of wetlands, drainage ways, lakes, ponds, etc.

(f) Mean high tide and areas prone to flooding.

(g) Surveyed location of all utilities in the immediate vicinity to the site including the size of the lines, capacities of generation or treatment plants, and current and projected utilization, and proposed expansion. Include the following utilities: water system with locations of fire hydrants; sanitary sewer system; storm drainage system with invert elevations; electrical gas system; telephone system; and other types of communication systems.

(h) Surveyed location, common and botanical name, size and condition of all trees with a diameter at breast height (DBH) of 100 mm (4 in) or greater.

(i) Surveyed location of buried tanks, IRP's and other hazards.

(j) Surveyed location of wildlife habitats (especially for threatened and endangered species).

(k) Soil and Foundation Conditions. Investigate soil and foundation conditions to ensure suitability of economical excavation, site preparation, building foundations, utility lines, grading, and planting. Make bearing capacity tests to ensure economical and stable foundations for buildings and other structures.

(l) Significant architectural or historical features or other preservation requirements.

(m) Significant climatic conditions including the following: average monthly temperature range; quantity and frequency of precipitation; midwinter and midsummer sunrise and sunset orientation and angle; prevailing wind direction throughout the year; and significant views to be enhanced or obscured.

(n) Detailed list of safety hazard requirements and distances including the following: fire protection clearances as discussed in Chapter 9; barrier-free design as discussed in Chapter 7; radon; flood control; protective design as discussed in Chapter 10; explosives safety clear zones; and airfield and helicopter clear zones as discussed in Appendix K.

(o) Explosives safety zones.

(p) Natural Resources. Consider natural resource values in the siting the facilities, AR 420-74 (reference 3-11) and TM 5-630 (reference 3-12). Evaluate the proposed use for renewable resource capability.

(3) Visual Impressions Survey. Provide an evaluation of the visual character of the site. This may include view boundaries, special visual features, vegetative character, microclimate conditions or sensory information.

(4) Other proposed improvements and changes that impact the site.

d. Opportunities and Constraints. The second step in evaluating the development potential of the site is the preparation of a site opportunities and constraints map. This map is a graphic representation of all of the positive and negative site characteristics analyzed in the site analysis that influence the location of the functions or elements in the site plan. To aid in the preparation of the site plan, include detailed analysis of slopes, drainage, trees to be preserved, views to be screened or enhanced, width of roadways and walkways, existing building footprints, size and

locations of other on-site and off-site natural or manmade features that impact the planning of the site.

(1) Orientation. Prepare energy conservation analyses for the best site orientation as discussed in Chapter 11.

(2) Cost Effective Design. Adapt projects to the topography and natural site conditions; require the minimum amount of cut and fill quantities; grading; and retaining walls. Preserve and enhance the landscape character and natural resources of the site and installation. The site layout shall reflect cost effective grading; orientation of functions; sustainable design; and construction techniques.

(3) Notification Regarding Projects Effecting the Use of Airspace. Construction and expansion or alteration on all airfields and heliports requires notification to the Federal Aviation Administration (FAA) in accordance with AR 95-50 (reference 3-13). This includes antenna structures, missile and rocket sites, navigational aids, and obstructions to navigation.

e. Limited or Confined Site. A key requirement for site verification is the determination that current user requirements obtained from the program analysis can be accommodated within the site defined. When the site is limited or confined and will not accommodate the project, the installation shall provide a different site or a revised project scope. Coordinate the scope with the user to redefine the facility to fit the site. Some methods may involve reducing the functional requirements; purchasing more land; or further simplifying the design. Use the site analysis to determine the appropriate requirements for the limited or confined site and record that information in the opportunities and constraints map.

f. Concept Plan. The next step in the process is the preparation of a plan. Plan preparation begins with the development of alternative plans. Alternative plans are sketch plans that provide organization of the spatial arrangements. Detailed site arrangements can be explored to achieve an optimal design that maintains the integrity of the approved area development plan and/or installation real property master plan. Evaluate the site analysis, functional relationships, and spatial arrangements to determine a preferred arrangement. Record the rationale for design decisions made during alternative plan development.

(1) Evaluation. Upon completion of the concept plans, the alternatives shall be evaluated and a preferred plan selected.

(a) Matrix. The evaluation process requires the preparation of an evaluation matrix that lists all the pros and cons that were defined during preparation of the alternative plans. The matrix aides the process to compare conflicting project demands to include site constraints, ideal solutions, costs, and future expansion. Evaluate the ability of the solution to meet quality design; project requirements; Installation Design Guide; and the goals and objectives. Each alternative shall include notations of challenges and benefits. Keep a record of the design strategies that were employed during the design decision making process. This information is utilized in developing an evaluation matrix for the final assessment of the alternatives. Information can be recorded on each plan or as a separate document.

(b) Design Team. The plans and their design strategies shall be reviewed by the design team, customer and user. Evaluate the planning matrix, the assets and liabilities of each alternative plan and the recommended preferred alternative. The preferred plan shall be the one that best addresses the preservation of the environment and natural resources; provides the best functional and spatial relationships; and meets the project goals and objectives.

(c) Approved Concept Plan. There shall be a consensus for the preferred alternative plan. The preferred plan may be one of the selected alternatives or a composite of the most desirable aspects of several or all of the alternatives. The review team prepares a definitive analysis of the assets and liabilities that led to the

selection. The preferred plan shall be presented and approved by the Installation Commander and the Installation Planning Board as the final step in the selection process. Site approval shall be in accordance with AR 210-20 (reference 3-10).

g. Site Plan. Development of the final site plan from the approved concept plan includes the development of a preliminary (sketch) site plan, final site plan and a design analysis. This plan is used to establish coordination of all design disciplines to proceed to development of construction drawings and a contract bid package.

(1) Preliminary (Sketch) Site Plan. The preliminary plan shall be prepared as a sketch plan. This plan is equivalent to a 35% design, ER 1110-345-700 (reference 3-15) and AR 415-15 (reference 3-14). The sketch plan shows the location of all program functions or elements on the site and indicate land use, circulation, and utilities. Develop the plan by using the site analysis. Present the plan to the installation review team for approval before the final site plan is prepared. The preliminary plan includes the following elements.

(a) Building envelopes or footprints.

(b) Setbacks to include building, circulation, environmental and safety clear zones.

(c) Existing and proposed vehicular circulation and parking to accurately portray the total number of vehicles accommodated.

(d) Existing and proposed pedestrian circulation, congregation plazas, and street furnishings.

(e) Landscape elements to include existing and proposed trees, shrub massing, and areas of trees to be preserved.

(f) Open space, athletic fields, and parade grounds.

(g) Service areas to include dumpster pads with screening.

(h) Future expansion.

(i) Utility corridors to include routes for gas, water, sewer, storm drain lines, telephone, electric, and steam, etc.

(2) Final Site Plan. The final site plans are developed from the approved preliminary (sketch) plans. These plans are developed as construction drawings to include a location plan, site plan; landscape planting plan; and utility plans.

(3) Design Analysis. The design analysis is prepared as required by ER 1110-345-700 (reference 3-15). The analysis is a record of the design decisions that lead to the final design supported by calculations, charts, matrices and diagrams.

5. SITE DESIGN CRITERIA.

a. Architectural Compatibility and Orientation. Orienting a building on a site is influenced by architectural compatibility; function and location relationships; and dimensional, environmental, solar and climatic factors. Architectural compatibility is defined as having a concern for the physical appearance to achieve the best life-cycle costs; and harmonizing with the site planning, landscape design, and interior design goals and objectives.

(1) Function Relationships. Site buildings in the proper land use area and in the best functional

relationship to each other. Functional relationships are impacted by the following: installation and user missions; function and operation efficiency; protective design as discussed in Chapter 10; fire protection as discussed in Chapter 9; and command and control.

(2) Location Relationships. Locate buildings to take advantage of the topography for cost effective construction and preservation of the character of the site. Group facilities by function. Location relationships are impacted by the following: vehicular circulation system; utility location; compatibility with surrounding land use and functions. The primary building is usually the most prominent single function or element and the center of site activity; easements and setbacks; and orientation to a slope.

(3) Dimensional Factors. Dimensional factors include the following.

(a) Buffer Zones. Buffer zones provide setbacks and public safety zones for the following: airfield and helipad clear zones as discussed in Appendix K; explosives safety clear zones; noise abatement; protective design as discussed in Chapter 10; fire protection clearances as discussed in Chapter 9; storage and handling hazardous material clearances; and separation of incompatible land use or functions.

(b) Facility Spacing. Spacing between buildings and functions is normally determined by the following: functional relationships; operational efficiency; protective design as discussed in Chapter 10; fire protection as discussed in Chapter 9; parking; future expansion; open space; safety clear zones; and setbacks.

(c) Building and Structures Area. The building and structures area is that area established by the site analysis as the best location for the program requirements.

(4) Environmental Factors. Environmental laws and criteria that impact building orientation are discussed in Chapter 2. The factors are protection, preservation and abatement.

(5) Solar and Climate Factors. Orient buildings to support the Energy Conservation Criteria as discussed in Chapter 11.

(a) Solar. Provide Life Cycle Cost Analyses (LCCA) as required. Accomplish special energy conservation studies for non-renewable resources as required. Provide an analysis of the orientation for facilities to be energy efficient.

(b) Climate. Climate conditions that impact the building orientation include prevailing winds and microclimate of the site.

b. Vehicular Circulation. This section provides the criteria and guidelines for determining the design vehicle, turning radii, and circulation. The guidelines cover access and service drives; and special vehicle-use areas including gateways, drop-offs, dumpsters, delivery, and drive-in facilities. Circulation will promote safe, cost effective, and efficient movement of both vehicles and pedestrians. Safe vehicular circulation systems have a perceivable hierarchy of movement, lead to a clear destination, and do not interrupt other activities.

(1) Installation Real Property Master Plan. Coordinate planning and design of the street network within each project site with the goals and objectives of the Installation Transportation Plan. Coordinate the placement of new facilities with the planned street system. The objective is convenient, cost effective and safe vehicular circulation.

(2) Site Traffic Impact Study. Prepare a Site Traffic Impact Study to determine circulation requirements and parking demand. An outline is provided in TM 5-803-14 (reference 3-7).

(3) Design Vehicle. Circulation and parking layouts are determined by applying the design vehicle templates to the site design. Vehicles are placed into two general classes: passenger cars and trucks as discussed in the AASHTO (reference 3-16). The passenger car class includes passenger cars, and light delivery trucks such as vans and pick-ups. The truck class includes single-unit trucks, recreation vehicles, buses, truck tractor-semitrailer combinations, and trucks or truck tractors with semi-trailers in combination with full trailers. The design vehicles for this section include both the passenger car and the truck classification.

(a) Design Vehicle Dimensions. Design circulation and parking to provide the vehicle clearances required to meet traffic safety for the vehicles that utilize the facility. Table 3-1 lists the dimensions for some of the more common vehicles.

TABLE 3-1 DESIGN VEHICLE DIMENSIONS

DESIGN VEHICLE (Symbol)	VEHICLE DIMENSION		BUMPER OVERHANG	
	Width m (ft)	Length m (ft)	Front m (ft)	Rear m (ft)
Passenger Car (P)	2.1 (7)	5.8 (19)	0.9 (3)	1.5 (5)
Single Unit Truck (SU)	2.6 (8.5)	9.2 (30)	1.2 (4)	1.8 (6)
Intermediate Semitrailer (WB-40)	2.6 (8.5)	15.3 (50)	1.2 (4)	1.8 (6)
Large Semitrailer (WB-50)	2.6 (8.5)	16.8 (55)	0.9 (3)	0.6 (2)
Single Unit Bus (BUS)	2.6 (8.5)	12.2 (40)	2.1 (7)	2.4 (8)
Motor Home (MH)	2.4 (8)	9.2 (30)	1.2 (4)	1.8 (6)

(b) Minimum Turning Radii. Table 3-2 lists the minimum turning radii for the same vehicles. An expanded list with additional dimensions and information can be obtained from the AASHTO (reference 3-16).

TABLE 3-2 DESIGN VEHICLE MINIMUM TURNING RADII

DESIGN VEHICLE	MINIMUM DESIGN TURNING RADIUS m (ft)	MINIMUM INSIDE RADIUS m (ft)
Passenger Car	7.3 (24)	4.7 (15.3)
Single Unit Truck	12.8 (42)	8.7 (28.4)
Intermediate Semitrailer	12.2 (40)	6.1 (19.9)
Large Semitrailer	13.7 (45)	6.1 (19.8)
Single Unit Bus	12.8 (42)	7.1 (23.2)
Motor Home	12.8 (42)	8.7 (284)

(c) Vehicle Template. The passenger car template is equivalent to a non-organizational - privately owned vehicle (POV). Templates showing the turning movements for other design vehicles are provided in the AASHTO (reference 3-16).

(d) Compact Passenger Car. Use compact passenger car parking stalls only when recommended by a Site Traffic Impact Study.

(4) Access and Service Drives. Design site entrances, exits, service drives, and special circulation areas to accommodate the largest vehicle that uses the facility. This procedure ensures the points of conflict; separation guidelines; corner clearances; sight distance; left turns; and entrances meet traffic safety requirements.

(a) Points of Conflict. Control driveway intersection access to minimize the conflicts between through traffic and vehicles entering and exiting the site. Limit points of conflict by applying the following guidelines.

1/ Reducing the number of access drives to one (1) two-way drive or a pair of one-way drives for each site. Drives may be added to the site when the daily traffic volume exceeds 5,000 vehicles per day (both directions) or when traffic using one drive would exceed the capacity of a stop-sign-controlled intersection during the peak (highest) traffic hour.

2/ Increasing the separation between drives; and drives and roadway intersections.

3/ Preventing certain maneuvers (e.g., left turns).

4/ Left turn lanes with backup storage for turning vehicles.

5/ Right turn deceleration and acceleration lanes for turning vehicles.

6/ Sight distances that allow safe entry and exit from the access road.

7/ Clear views and signage of entry to the site from the access road.

8/ Topography and vegetation that define entrances to the site.

9/ Maximum separation between access drives occurring on the same roadway.

10/ Alignment of access drives across from each other.

11/ Right-angle turns from the roadway onto the access drive with adequate turning radii.

12/ Adequate road width and length at entrances to channel vehicles smoothly into the proper lanes.

13/ Provisions for special vehicles that require greater turning radii and driveway widths.

(b) General Guidelines. Design access drives to provide the following.

1/ Take vehicles to their destination and return with minimum interference or travel through parking areas, service areas or emergency zones.

2/ Enter and exit the site at the same point or on the same roadway to discourage through traffic on site.

3/ Accommodate two-way traffic since one-way systems can create confusion.

4/ Provide separation of service drives from emergency drives.

(c) Separation Guidelines. Design access drives to provide the following separation.

1/ Maintain 61 m (200 ft) or more between access drives on arterial roads. Table 3-3 provides minimum separation when frontage along an arterial road is limited.

TABLE 3-3 MINIMUM DRIVEWAY SPACING FOR STREETS SERVING MORE THAN 5,000 VEHICLES PER DAY

ARTERIAL SPEED kph (mph)	MINIMUM SEPARATION m (ft)
32 (20)	25.9 (85)
40 (25)	32 (105)
48 (30)	38 (125)
56 (35)	45.8 (150)
64 (40)	56.4 (185)
72 (45)	70.2 (230)
81 (50)	83.9 (275)

2/ Maintain a minimum 366 m to 457 m (1200 ft to 1500 ft) separation between a signaled drive and adjacent signaled intersection. When the signaled drive is a T-intersection, provide a minimum 183 m (600 ft) separation when frontage is limited.

3/ Coordinate the location of drive signals within 762 m (2500 ft) of adjacent signals.

4/ Maintain between 10.5 m to 15.5 m (35 ft to 50 ft) separation on low-volume (5000 vehicles per day), low-speed (48 kph (30 mph)) roads.

(d) Corner Clearances. Access drives designed near major intersections adversely impact traffic operations. They may result in unexpected conflicts with vehicles turning at the intersection. Maintain a minimum 15.2 m (50 ft) clearance between access drives and major intersections.

(e) Sight Distance. Provide safe sight distance for vehicles entering and exiting an access drive. This sight distance increases according to the design speed of the through road. The relationships of speed to sight distances are provided in Table 3-4. When a safe sight distance cannot be met, consider the following.

1/ Removal of sight obstructions.

2/ Relocation of the access drive to a more favorable location along the access road.

3/ Prohibition of critical movements at the access drive.

4/ Relocation of the access drive to another access road.

TABLE 3-4 MINIMUM SIGHT DISTANCES

OPERATING SPEED (kph (mph)	32 kph (20 mph)		48 kph (30 mph)		64 kph (40 mph)		81 kph (50 mph)	
	Left m (ft)	Right m (ft)	Left m (ft)	Right m (ft)	Left m (ft)	Right m (ft)	Left m (ft)	Right m (ft)
Passenger Car	64 (210)	52 (170)	99 (320)	112 (360)	167 (540)	183 (590)	279 (900)	301 (970)
Truck	112 (360)	71 (30)	161 (520)	140 (450)	285 (920)	285 (920)	468 (1510)	474 (1530)

NOTE: Sight distance criteria includes the following.

1. Upon turning left or right when exiting the access drive, the vehicle accelerates to the operating speed of the access road without causing approaching vehicles to reduce speed by more than 16 kph (10 mph).
2. Upon turning left when entering the access drive, the vehicle clears the near half of the access road without causing approaching vehicles to reduce speed by more than 16 kph (10 mph).
3. Turns are 90-degree.
4. The access road and the access drive are on level terrain.

(5) Left Turns. Design left turns on the through road to limit points of conflict under the following conditions.

(a) Inadequate corner clearance.

(b) Inadequate sight distance.

(c) Inadequate separation between driveways.

(d) Inadequate separation between median openings.

(6) Entrances. Design entrances and exits for access drives to provide the following.

(a) Minimum turning radii for the largest vehicle expected to use the site.

(b) Minimum 3 m (10 ft) wide traffic island where entry and exit lanes into the site are separated.

(c) Minimum throat widths and lengths to accommodate incoming and outgoing traffic.

(d) Sufficient width to accommodate single-lane or double-lane traffic depending upon the design vehicle.

(e) Minimum 30.5 m (100 ft) clear sight distance for turns from parking lots and service drives onto the access drive.

(7) Street Grading and Drainage. Design access drives with gradients that conform to the natural

topography using commonly accepted minimum and maximum gradients, TM 5-820-4 (reference 3-17). Grades and slope directions are determined by utilizing the drainage requirements established in the Surface Water Management Plan. Additional information on the grading of entrance and exit drives is provided in TM 5-822-2 (reference 3-18).

(8) Pavement. Guidance for the design and engineering of road and street pavements is provided in TM 5-822-5 (reference 3-19).

(9) Traffic Control. Information on devices to control traffic is provided in the Manual on Uniform Traffic Control Devices for Streets and Highways (reference 3-20).

(10) Street Lighting. Guidance for the design of street lighting is provided in TM 5-811-1 (reference 3-21).

c. Special Circulation Areas. Circulation areas for other than passenger car traffic have special requirements to meet traffic safety. These areas require additional space to accommodate unusual traffic patterns and to provide greater turning radii for maneuverability. The areas include gateways; drop-off areas; delivery and service zones; dumpsters; drive-in facilities; and emergency vehicle access.

(1) Gateways. Discuss design for gateways with the Provost Marshal and coordinate the requirements with the Installation Physical Security Plan; and TM 5-853-2 (reference 3-4), TM 5-853-3 (reference 3-5) and Chapter 10. Design gate areas to provide the following.

(a) Adequate width for a gatehouse, traffic island, travel lane and pullover lane.

(b) Adequate length on the access drive to accommodate stacking of vehicles and to allow a transition zone into and out of the major traffic flow.

(c) Curbs around traffic islands for vehicle control.

(2) Drop-Off Areas. Provide drop-off areas for office, commercial, educational and community facilities with high use. Consider the following guidelines.

(a) Drop-Off Area Grade Criteria. Maintain a minimum 1% gradient across the area.

(b) Locating drop-off areas at or near the front of the building apart from entries into parking lots.

(c) Designing drop-off areas away from the building to provide a separate drop-off and stacking area for buses and shuttles.

(d) Locating courier service parking stall requirement at the primary or secondary entrance.

(e) One-way loop to avoid confusion.

(f) Adequate area to avoid vehicle points of conflict with the traffic flow. Where a circular turn-around is required, the design radius supports the selected design vehicle.

(g) Barrier-free design as discussed in Chapter 7.

(h) Adequate width and length to accommodate the safe movement of vehicles to and from traffic flow.

(i) Adequate area for stacking of vehicles.

(3) Delivery and Service Zones. Delivery and service vehicles range in size from pickup trucks to large single unit trucks. Design service areas to provide space for the largest service vehicle that would use that area. Design delivery and service zones to provide the following.

(a) Delivery and Service Zones Grade Criteria.

1/ Maintain positive drainage a minimum 1% gradient for away from the loading dock. This grade meets the vehicular circulation grade.

2/ Maintain a vehicle circulation gradient between a minimum 1% slope or a maximum 3% slope to the loading dock. This grade meets the positive drainage gradient away from the dock.

(b) Separate service access drives from parking circulation as there are points of conflict between the functions. Service access that is required through a parking area goes straight to and straight out of the service area from the street. Delivery and service trucks need to access service doors in buildings.

(c) Necessary turning movements on a dead-end service drive. These vehicles generally require larger turning radii, maneuver area, and standing area while deliveries or service occurs. Dock facilities need to accommodate the maneuver area required for the design vehicle.

(d) Placing the zones at the rear or sides of buildings.

(e) Visual screening with walls, fences or plant material.

(4) Dumpsters. The design of garbage and trash removal areas is controlled by the size and location of the dumpster. The dumpster is provided by the local trash management company. Design dumpster pads to provide the following.

(a) It is preferable for trucks to maintain a forward movement through the site. Design for sanitation trucks to approach the pad in a straightforward manner, align with the dumpster, reverse away from the pad and exit forward from the site. This procedure requires minimal maneuvering.

(b) Convenient pedestrians access to the dumpster.

(c) Reduce visual impact.

1/ Screen with plant material, fences or walls.

2/ Be removed physically and visibly from building entrances; and major vehicular and pedestrian circulation routes.

(d) Locate dumpsters on concrete pads.

(e) Positive drainage away from the pad.

(5) Drive-In Facilities. Drive-in facilities require careful and clear establishment of traffic patterns and a continuous traffic flow. The standard configuration for a single-service or double-service position facility does not lend itself to a two-lane approach and departure design. It usually relies on some form of loop system. Design drive-in facilities to provide the following.

(a) Parking Stall Allowance. Provide a parking stall allowance that is 17.5 stalls per 93 m^2 (1,000 ft^2) building area .

(b) Vehicle Stacking Distance Allowance.

1/ Provide a minimum 55 m (180 ft) vehicle stacking distance in the drive-through lanes.

2/ Provide a vehicle stacking distance on-site to prevent traffic points of conflict with traffic flow on access roads. Stacking distance is determined by subtracting the number served (serving time averages 2-3 minutes per customer) from the expected arrivals per 15 minute period (4-14 minutes is the average) and multiplying the difference times 6.0 m (20 ft).

(c) Maintain traffic lanes into and out of the drive-in windows to prevent points of conflict with other on-site vehicular traffic flow to include parking.

(d) Minimize points of conflict with pedestrian circulation.

(e) Curb and islands for vehicle control.

(f) Adequate pavement markings.

(6) Motorcycle Parking. Design motorcycle parking to provide the following.

(a) Locate parking close to building entrances.

(b) Locate parking in parking lot corners.

(c) Place parking on a concrete pad.

(d) Visible signage and pavement markings.

(7) Emergency Vehicle Access. Provide for the access, circulation, and parking of emergency vehicles as required. Design emergency vehicle access drives to provide the following.

(a) Ambulance vehicle access to all buildings.

(b) Sufficient radii for the ambulance vehicle to turn and exit the site.

(c) Fire truck access between buildings. This access may be provided on sidewalks, paths or turf areas designed for the vehicle.

d. Street Tree Program. The use of street trees is one of the most effective means to enhance and define the road hierarchy. Use landscape design principles and the guidelines below to establish a coordinated street tree program. The program supports the goals and objectives of the installation real property master plan. The selection of tree species, spacing and location has a relationship to the road hierarchy. Develop a pallette or list of readily available native, hardy trees with suitable growth characteristics. Use a variety of disease and insect resistant species.

(1) Tree Species Allowance. Maintain a maximum 5% of each tree species in the cantonment area of an installation. This formula reduces the visual and microclimate impact of tree removal of a species affected by

disease or pest.

(2) Traffic Safety. The selection, location and spacing of street trees accommodates traffic safety requirements. Maintain sight distances to include the 1300 mm (52 in) motorist eye level view height.

(3) Installed Tree Measurement. Install deciduous trees at a minimum 65 mm (2 ½ in) caliper. Install flowering and evergreen trees at a minimum 2400 mm to 3000 mm (8 ft to 10 ft) height.

(4) Tree Selection Factors. Site factors that determine the suitability of a tree to the site is its adaptability to exposure of temperature and light; surrounding surfaces; physical barriers; and soil conditions. Tree characteristics that determine suitability include its hardiness, form, salt tolerance; drought and flood tolerance; and litter from blossoms, branches, and fruit.

e. Non-Organizational - Privately Owned Vehicle (POV) Parking. Authorized parking allowances for POV and visitor parking allowances by facility type are provided below. POV vehicle parking includes on-street parking, off-street parking lots and parking structures. Provide parking in lots or structures with a limited number of entrances and exits onto the access road or drive. Align entrances and exits into different lots on the same site or provide adequate separation to provide traffic safety and meet sight distance requirements. Design and layout the parking facilities in accordance with TM 5-803-14 (reference 3-7) and the guidelines that follow. Design parking areas to provide the following.

(1) Barrier-free design as discussed in Chapter 7.

(2) Parking located within convenient walking distance of a building entrance.

(3) Parking for high turn-over or short-term use located in a separate lot or placed nearest the entrance. Examples of high turn-over or short term use include: visitor, outpatient or delivery parking.

(4) Align parking aisles towards the building entrance to encourage safe pedestrian circulation and limited points of conflict between pedestrian and vehicular circulation.

(5) Sustainable design principles.

(6) On-Street Parking. On-street parking is discouraged due to points of conflict with traffic flow. On-street parking shall be of sufficient length and width to allow safe movement into and out of the stall and to adequately separate the parked vehicle from the traffic flow.

(7) Joint Use Parking. In the interest of economy and land use efficiency, provide joint use parking. The best opportunity for this function to occur is when a predominately daytime activity is adjacent to a predominately evening activity; or a weekday activity is adjacent to a weekend activity.

(8) Off-Street Parking. Locate off-street parking facilities near the function served.

(a) Layout. A 90-degree parking layout is preferred. Where a fast rate of turnover is expected or where required by site limitations, a 45 degree or 60 degree angle layout may be used. Design the parking layout to provide the following.

1/ Maintain two-way movement.

2/ Avoid dead end parking lots.

3/ More than one entrance and exit for parking lots with more than 100 stalls.

4/ Traffic breaks in aisles greater than 107 m (350 ft) in length.

5/ Curbs or a painted lines at the ends of stalls to control placement of vehicles.

6/ Walkway widths to allow comfortable pedestrian circulation with vehicle overhang.

7/ Curb cuts for barrier-free access.

8/ Meet snow removal requirements.

(b) Barrier-Free Parking. Provide barrier-free design as discussed in Chapter 7. Use local requirements when they are more stringent. Stall dimensions to accommodate barrier-free design are discussed in Chapter 7, and include the following.

a/ Passenger car stall dimensions: 4 m x 5.5 m (13 ft x 18 ft).

b/ Van stall dimensions: 4.9 m x 5.5 m (16 ft x 18 ft).

(c) Stall and Aisle Area Allowance. Provide a passenger car design vehicle stall and aisle allowance between 33 m^2 to 37.2 m^2 (355 ft^2 to 400 ft^2) area per vehicle. This area allowance provides for the parking stall and one half of the circulation aisle.

(d) Stall Dimension Allowance.

1/ With Vehicle Overhang. Provide a passenger car design vehicle overhang, parking stall dimension maximum 2.7 m x 4.9 m (9 ft x 16 ft) allowance.

2/ Without Vehicle Overhang. Provide a passenger car design vehicle without an overhang, parking stall dimension maximum 2.7 m x 5.5 m (9 ft x 18 ft) allowance.

3/ Compact Passenger Car. Use only when recommended by a Site Traffic Impact Study. The following data is provided for information only. Provide a compact passenger car design vehicle without an overhang, parking stall dimension maximum 2.4 m x 4.9 m (8 ft x 16 ft) allowance.

(e) Aisle and Access Lane Width Allowance. Provide an aisle and access lane maximum 7.3 m (24 ft) width allowance.

(9) Parking Stall Quantity. Criteria for determining the appropriate number of parking stalls for authorized POVs by facility type are listed in Table 3-5. The criteria is based on average historical data from traffic analyses made at numerous installations and are considered acceptable norms. In the event the user requires a greater percentage than is listed in Table 3-5, a Site Traffic Impact Study may be developed to determine the parking requirements based upon the evaluation criteria, projected traffic generation, and traffic analysis. A Site Traffic Impact Study outline is provided in TM 5-803-14 (reference 3-7).

(a) Evaluation Criteria. The scope requirements to be evaluated include the following: maximum utilization; the total number of employment; average number of employee absence; total number of users; total number of visitors; total number of outpatients; total number ride sharing; total number riding public transportation; and estimated future employment growth.

(b) Facility Type Not Listed. When the facility type is not listed in Table 3-5, base the parking stall quantity on the Site Traffic Impact Study.

(c) Delivery and Service Parking. Provide additional stalls in the delivery and service zone for delivery and service vehicles.

(d) Visitor Parking. The Appendices by facility type provide the criteria to be used to determine the authorized visitor parking stall quantity.

TABLE 3-5 AUTHORIZED PARKING STALL QUANTITIES BY FACILITY TYPE FOR NON-ORGANIZATIONAL - PRIVATELY OWNED VEHICLES (POV)

FACILITY TYPE	NUMBER OF PARKING STALLS
Administration, Headquarters and Office Buildings.	60% of assigned personnel.
Bakeries.	38% of civilian employees; largest shift.
Bank and Credit Union (When not included in a Community Shopping Center).	2% of authorized customers served.
Cafeteria, Civilian (When not included in a Community Shopping Center).	15% of seating capacity.
Central Food Preparation Facilities.	38% of military and civilian food service operating personnel; largest shift.
Chapels.	30% of seating capacity.
Child Development Centers.	1 stall per every 4 children and 100% of staff.
Community Shopping Centers; may include the following functions: Bank, Commissary Store, Food Sales, Main Exchange, Miscellaneous Shops, Post Office, Restaurant, and Theater.	4% of authorized customers served and other criteria that is provided by The Defense Commissary Agency (DeCA) and Army and Air Force Exchange Service (AAFES).
Enlisted Personnel Dining Facilities for the following: Permanent party; Garrison (to include both TOE and TDA units); Support Units; Construction Battalions, Weapon Plants; Personnel Transfer and Overseas Processing Centers.	38% of military and civilian food service operating personnel; largest shift; plus 8% of enlisted personnel (patron parking) to be served during a meal period.
Family Housing.	2 stalls per living unit.
Field House (Combined with Football and Baseball Facilities).	1% of military strength.
Fire Stations, One-Company.	7 stalls.

TABLE 3-5 AUTHORIZED PARKING STALL QUANTITIES BY FACILITY TYPE FOR NON-ORGANIZATIONAL - PRIVATELY OWNED VEHICLES (POV)

FACILITY TYPE	NUMBER OF PARKING STALLS
Fire Stations, Two-Company.	10 stalls.
Guard Houses; Military Police Station.	30% of guard and staff strength.
Gymnasiums (When only 1 on the installation).	1% of military strength served.
Gymnasiums, Area (Regimental).	10 stalls.
Laundries and Dry Cleaning Plants.	38% of civilian employees; largest shift.
Libraries, Central.	1 stall for each 47 m^2 (500 ft^2) gross floor area.
Libraries, Branch.	8 stalls.
Maintenance Shops.	38% of assigned personnel; largest shift.
Schools, Dependent; without auditorium.	2 stalls per classroom.
Schools, Dependent; with auditorium.	2 stalls per classroom; plus 15% of auditorium seating.
Security Offices for Main Gates only, on installations with a population of: 100 to 2,000 population. 2,001 to 4,000 population. 4,001 to 6,000 population. 6,001 to 10,000 population. 10,001 and over population.	 5 stalls. 10 stalls. 15 stalls. 20 stalls. to be based on a Site Traffic Impact Study.
Service Clubs.	2% of enlisted personnel or officer strength served.
Swimming Pools.	20% of design capacity of the swimming pool.
Temporary Lodging Facilities.	100% of bedrooms.
Theaters (When not included in a Community Shopping Center).	25% of seating capacity.
Unaccompanied Enlisted Personnel Housing.	Minimum 70% of maximum utilization.
Unaccompanied Officer Personnel Housing.	100% of living suites.
Warehouses.	1 stall for each 46.5 m^2 (500 ft^2) gross office area; plus 1 stall for every 4 persons assigned to the storage activity.

(10) Islands and Medians. Locate islands at the ends of parking stalls and intersections of parking aisles.

(a) Turning Radii. Provide islands that meet the vehicular movement turning radii and protect the end stalls. Base turning radii upon the largest vehicle using the parking lot. Include turning radii that is sufficient to allow safe movement without points of conflict with the island and/or curbing.

(b) Pedestrian Circulation. Islands and medians can be partially or completely paved to service pedestrian traffic. Pedestrians tend to use vehicle circulation aisles, especially when medians are not generous or do not allow for comfortable movement between vehicles. When the median is designed as a sidewalk, provide a width that allows for both pedestrian circulation and vehicle overhang.

(11) Landscape Plant Material. Provide large parking lots with a generous portion of landscape planted islands to improve visual quality; provide scale; enforce the road hierarchy; and provide screening. Guidance for the selection and placement of plant material is provided in TM 5-803-13 (reference 3-6). The purpose for placing plant material in parking islands and/or medians is to accomplish the following: provide separation of vehicle and function; break up the expanse of impermeable surface; provide a visual quality to the spatial arrangement; and preserve existing plant material.

(a) Green Space Allowance. The planted area within and around a parking lot is usually based on a proportional amount of "green" space to paved area. Allocate a minimum 10% area of the total paved parking area for landscape plant material. This area allowance may extend a maximum ten (10) feet outside the perimeter of the parking area.

(b) Tree Trunk or Pole Clearance. Table 3-6 provides parking island width guidance to allow space or clearance to accommodate plant material and light poles. The minimum distance from an existing tree trunk to the edge of pavement shall be 1200 mm (4 ft) or one-half (½) the distance from the tree trunk to the outer edge of the tree drip line, whichever is greater.

TABLE 3-6 PARKING ISLAND WIDTHS TO ACCOMMODATE PLANT MATERIAL

Minimum 1.5 m (5 ft)	Grass, Groundcover, and Small Shrubs
Minimum 2.4 m (8 ft)	Light Standards, Medium Trees and Medium Shrubs
Minimum 3 m (10 ft)	Large Trees and Large Shrubs

(c) Motorist View Height. Maintain the 1300 mm (52 in) motorist eye level view height when providing plant material.

(12) Parking Lot Grading and Drainage. Parking lot grades and slope directions are determined by the drainage requirements established in the Surface Water Management Plan. Design positive drainage in parking lots to provide the following.

(a) Parking Lot Grade Criteria. Provide a minimum paved area 1% gradient.

(b) Parking Stall Grade Criteria.

1/ 90 Degree Parking Stall. Provide a 90 degree parking stall with a maximum front to rear end 5% gradient and a maximum side to side 1 ½% gradient.

2/ 45 Degree or 60 Degree Parking Stall. Provide a 45 degree or 60 degree parking stall with a maximum front to rear end 5% gradient and a maximum side to side 1% gradient.

(c) Use islands and medians to accommodate change in elevation between the access drive and parking areas or between different parking levels.

(d) Sheet flow across small flat parking lots into inlets or swales. Maintain a relatively constant grade across the lot.

1/ Swales in Turf Areas. Design the swales to meet erosion control and the sheet flow velocity entering them.

2/ Swale Depth Criteria. Provide a swale cross section with a minimum 300 mm (12 in) depth.

(e) Control runoff with curbing that directs the runoff to the sides and corners of parking lots containing more than 100 stalls.

(f) Control runoff with curbing that directs the runoff to the sides and corners of steep sloped parking lots where inlets are located.

(g) Avoid channeling the sheet flow.

(h) Avoid ponding water.

(i) Avoid creating an impoundment zone in the center of the lot.

(j) Sufficient spot elevations to move water off the lot.

(k) Adequate drainage inlets to move water off the lot.

(13) Street Lighting. Illuminate parking lots with uniform lighting coverage to meet pedestrian and vehicular safety requirements. Guidance for determining parking area lighting requirements is provided in TM 5-811-1 (reference 3-21).

(14) Pavement Marking and Signage. Guidance on pavement marking and signage is provided in the Manual on Uniform Traffic Control Devices for Streets and Highways (reference 3-20).

f. Petroleum, Oil and Lubrication (POL) Parking Areas. Design criteria for facilities required to support fueling activities is provided in MIL-HDBK-1022 (reference 3-22). These facilities include operations buildings, contaminated fuel recovery systems, roads, utilities, and parking areas.

g. Parking Garages. Design parking garages as architectural structures with the design vehicle applied as described above.

h. Mitigating Vehicle Impact. Circulation and parking areas consume large land areas with impervious paved surfaces. Explore all possible methods of mitigating the visual and microclimate impacts of circulation and parking areas. Buffers, topography, screening, and plant material methods of mitigation are described as follows.

(1) Buffers. Provide a minimum 6.1 m (20 ft) wide buffer strip to separate parking areas from adjacent streets. Provide a minimum 2.4 m (8 ft) wide buffer strip in limited areas.

(2) Topography. Design parking areas to economize construction by conforming to existing topography and balancing the cut and fill quantities. When there are no other alternatives to siting the parking on steep slopes, terrace the parking lot into the slope and provide more than one level of parking.

(3) Screening. Design the parking screens to be compatible with the natural or architectural character of the site. Design the screen relative to the 1300 mm (52 in) motorist eye level view height. It may be impractical and unsafe to provide continuous screens around large parking areas. Examples of screens include the following: walls, fences, berms, change of elevation and plant material.

(4) Plant Material. The selective placement of trees, shrubs and ground cover in randomly selected parking stalls break up the visual impact of large areas of vehicles and provide an irregular pattern of planted islands.

i. Pedestrian Circulation. Pedestrian circulation accommodates the movement of people by foot. Design pedestrian circulation to be convenient, safe, and separated from vehicular circulation. Design sidewalks in accordance with TM 5-803-5 (reference 3-8), TM 5-803-14 (reference 3-7) and TM 5-822-2 (reference 3-18). Provide barrier-free design as discussed in Chapter 7. Base the width of sidewalks on the pedestrian traffic volume and fire truck access requirements.

(1) Desire Lines Study. Base pedestrian circulation on the pedestrian's desire line to follow the most direct route when walking between two points. Prepare the desire line study as follows.

(a) Desire lines are drawn to anticipate pedestrian routes to prevent crisscrossing the site with sidewalks.

(b) Weight desire lines according to the most traveled routes.

(c) Coordinate circulation routes with building layouts.

(2) Sidewalk Systems. Sidewalk systems are developed from the Desire Line Study. The system incorporates required and anticipated access to include barrier-free requirements. There are three types of sidewalk systems that meet varying site demands: grid, curvilinear, and organic. All three systems provide functional access between facilities and include the following.

(a) Grid. A grid sidewalk system is composed of straight lines with right-angle intersections. It enforces a visual line of sight to the most direct route. The grid system is appropriate in areas with strong architectural definition.

(b) Curvilinear. A curvilinear sidewalk system is less formal. Use a curvilinear sidewalk system to encourage a flowing pedestrian circulation through the open space when direct access to facilities is not critical.

(c) Organic. Organic sidewalk systems are unique in that the sidewalk patterns are defined by the space it flows through and varies in width. Organic sidewalks have irregular appearance and respond to natural elements in the surrounding landscape.

(3) Pedestrian Concentration. The area required to accommodate pedestrian movement increases at the point of origin and destination. Pedestrian movement is also interrupted when people meet, gather, wait or sit. In

areas of pedestrian concentration develop the space to accommodate these needs. Examples of pedestrian concentration areas include: building entrances, drop-off areas, sidewalk intersections, and open spaces between buildings. Design pedestrian concentration areas to provide the following.

(a) Wide walkways at the points of origin and destination. Provide adequate reception area at building entrances.

(b) Wide paved areas at pathway intersections to allow for both congregation and circulation.

(c) Adequate area for people to concentrate outside of the pedestrian flow.

(d) Areas for people to sit on the edge or outside of the pedestrian flow.

(e) Both shaded and sunny areas for people to congregate or sit. Consider the need for shelter at waiting areas.

(4) Troop Formation Areas. Installations require muster areas and circulation routes for troops marching in formation between classrooms, barracks, dining halls and parade grounds. Design these areas and walkways to provide adequate sizes and surfacing to accommodate personnel.

j. Erosion and Surface Water Management. The primary functions of surface water management are to establish positive drainage; prevent flooding and erosion. Proper management techniques also provide storm water infiltration, habitat preservation, and recreational opportunities. Design surface water management to replicate natural systems and maintain public safety, health and welfare. The guidelines discussed below refer to general on-site drainage design. Consult specific criteria developed by local and state agencies. Additional guidance on drainage design is provided in TM 5-820-4 (reference 3-17).

(1) Impervious Surface. The placement of facilities on a site changes drainage patterns by increasing impervious surfaces. These surfaces are rooftops and pavements. This results in a greater volume and velocity of water to be managed. Design the impervious surfaces to provide the following.

(a) Avoid creation of unnecessary impervious surfaces.

(b) Diffuse drainage evenly across the site. Avoid concentrating drainage at one point by dividing the site into more than one drainage basin.

(c) Large expanses of impervious surface divided into smaller areas to control runoff; reduce the size of necessary drainage structures; and avoid drainage system back-up. Use soil areas between impervious surfaces for infiltration and introduction of plant material.

(d) Islands, medians, curbs and gutters to control drainage within parking areas. Curbs may be designed to allow runoff into detention catch basins for temporary storage or infiltration.

(e) Porous surfaces as paving alternatives that allow infiltration. Examples of porous surfaces include: porous asphalt and concrete; gravel; open-cell paving systems; and turf.

(2) Grading. Topography is the primary determinant for the direction and velocity of runoff. Maintain existing drainage patterns. Site facilities and parking areas to take advantage of existing topography. Graded slopes shall be gradual and avoid abrupt changes in gradient. Design positive drainage across the site to provide the following.

(a) Direct water away from structures. Identify the finished floor elevations of buildings to ensure water shall not back up into the buildings.

(b) Prevent water from ponding at low points or in low areas.

(c) Direct concentrated water flow from pedestrian circulation.

(d) Slope Gradient Criteria. For turf areas provide a minimum 1.5% gradient. Provide positive drainage away from buildings that is between a minimum 150 mm (6 in) vertical in 3000 mm (10 ft) horizontal gradient or a maximum 300 mm (1 ft) vertical in 900 mm (3 ft) horizontal gradient.

(3) Drainage Control. Direct storm drainage from buildings and other impervious surfaces to a storm drainage system. Drainage can be controlled and redirected using various methods as follows.

(a) Vegetated Swale or Ditch Gradient Criteria. Provide vegetated swales or ditches positive drainage at a minimum 2% gradient.

(b) Paved Swale or Ditch Gradient Criteria. Provide paved swales or ditches positive drainage at a minimum 1% gradient.

(c) Check dams or weirs are used to slow water movement and increase infiltration in porous swales or ditches. Earth, stone, rip rap, gabions, and concrete are generally the best materials for dam and weir construction.

(d) French drains are cost effective for directing small amounts of runoff.

(e) Underground storm drains.

(4) Detention Ponds, Retention Ponds, and Infiltration Basins. Detention ponds, retention ponds, and infiltration basins are drainage devices used to control the quantity and velocity of runoff. The increase in runoff is held within these ponds and slowly released at rates that are equal to or less than the rates that occurred before site improvements. The maintenance of runoff rates help prevent flooding, erosion and sedimentation of recipient drainage ways. Ponds and basins can be designed to allow collected runoff to stand long enough for heavier sediments to settle to the bottom, thereby reducing sedimentation downstream. Design these ponds and basins to serve other functions; such as, water feature, wildlife habitat, wetland, and wastewater reclamation.

(a) Detention Ponds. Detention ponds release all of the collected water at a designed rate. Detention and retention ponds are especially useful during construction when the lack of drainage systems and vegetative cover make it difficult to control storm water flow and erosion.

(b) Retention Ponds. Retention ponds function the same as a detentions ponds except they are designed to retain a certain level of water permanently. The ponds release the collected water above the permanent level at a designed rate.

(c) Infiltration Basins. Infiltration basins retain all of the collected water until it infiltrates or evaporates. Infiltration basins are important for increasing groundwater. Infiltration basins are wide and shallow to facilitate rapid infiltration and evaporation. Basin floors are graded at 0% or close to 0% and have a permeable base. Infiltration basins are designed to be dry when not in use and can serve other functions as well, such as athletic playing fields.

(d) Local and State Agencies. These agencies are requiring the use of detention/retention and

infiltration ponds as a means of maintaining water quality. Verify the requirements for designing detention ponds, retention ponds, and infiltration basins with the local and state agencies.

k. Dust Control. Control measures for dust erosion are required by site conditions and a requirement to rehabilitate areas scarred or denuded during construction. Dust control evaluation and implementation begins with identifying the causes and then implementing controls to limit the condition.

(1) Dust erosion occurs as the result of the following: lack of vegetative cover; improper grounds maintenance; overuse of the land; unstable soils; saline conditions; extreme temperature or a combination of the above.

(2) Dust control may consider the following: geotextile fabrics; re-vegetating the area with hardy plant material; irrigation; soil stabilization; or scheduling limited use of the area.

l. Siting Utilities. Minimize utility systems impact to the natural site while meeting basic economic and functional criteria. Analyze utility demand to include the integration of existing utility systems and future requirements. Plan utility lines by considering the following.

(1) Utility Easements or Right-of-ways. Use utility corridors to minimize environmental disturbance and simplify maintenance. Locate these corridors along the perimeter. Realignment of existing systems will increase the cost of future development.

(2) Minimize capital investments and life-cycle maintenance or repair costs.

(3) The location, size and elevations of sanitary sewers; storm drains or open drainage; drain inlets; and manholes.

(4) The location, size, and elevations of existing water supply, gas, and heat transmission mains.

(5) The location and size of electrical service; street lighting; telephone lines; manhole and pole locations; and underground electrical service.

(6) The location of fire alarm call boxes as discussed in Chapter 9.

(7) The location and existing supply feeder lines and utility generation plants. Shortest or direct route to off-site utility trunk line connections

(8) Future expansion.

(9) Visual Appearance. Consider the visual impact of above ground utilities in accordance with the Installation Design Guide. Locate utility transformers and transclosures for underground utilities to ensure ease of maintenance or repair. Locate transformers and transclosures with adequate setbacks from vehicular circulation and parking.

(10) Installation Physical Security. The access, design, location, and visibility of each function, element or system includes the consideration for the need of protective construction measures in accordance with the Installation Physical Security Plan.

(11) Underground Utilities. Locate underground distribution lines to ensure cost effective maintenance or repair. Locate utilities in common corridors. Avoid underground utility conflicts with vegetation; provide protection from storm damage; and enhance the visual quality of the installation.

m. Landscape Design and Planting. The objective of landscape design is to preserve and enhance the existing resources; improve the environmental quality of the installation; minimize life-cycle maintenance; and improve visual quality. Landscape design principles are discussed in TM 5-803-13 (reference 3-6). Consider landscape design principles during the planning and design process. Sustainable design is achieved through the implementation of the landscape design principles. Coordination of these principles with the other design disciplines is critical to the overall success and acceptance of the project.

(1) Landscape Design. Landscape design principles are used to accomplish the following.

(a) Preserve habitats and natural resources.

(b) Mitigate environmental hazards and nuisances.

(c) Separate incompatible land use or negative visual impressions.

(d) Modify environmental conditions; such as, temperature, wind and glare.

(e) Frame visual zones and articulate open space.

(f) Introduce human scale and unity.

(g) Soften architectural elements.

(h) Balance and harmonize the visual environment.

(2) Planting Plan. A landscape planting plan is an integral part of the project site development. Follow the planting guidance in TM 5-803-13 (reference 3-6), the Installation Landscape Planting Plan, TM 5-630 (reference 3-12) and the Installation Design Guide. Select landscape plants that are native and hardy to the site and low maintenance. Landscape plant material enhance the quality of life by accomplishing the following.

(a) Harmonize and frame the built environment.

(b) Buffer incompatible functions.

(c) Barrier control between functions.

(d) Seasonal interest.

(e) Screen for privacy or area separation.

(f) Sustainable design by purifying the air; temperature modification; controlling erosion, sediment and dust; and abating noise.

(g) Phytoremediation: defined as the use of plants and trees to remediate contaminated soil, surface water, and groundwater. This procedure is most successful at sites with low levels of contamination; and where affected soils and groundwater are close to the surface.

n. Installation Physical Security. Develop a site design for installation physical security to reduce vulnerabilities resulting from identified threats. Determine physical security requirements by coordinating with the Provost Marshall, TM 5-853-2 (reference 3-4) and TM 5-853-3 (reference 3-5).

(1) General. Site design to obtain physical security includes the following guidelines.

(a) Determining level of threat.

(b) Limiting access to the site and facilities.

(c) Maintaining adequate standoff distances; clear zones; and distances from uncontrolled areas.

(d) Maximizing exposure on the site perimeter to allow discovery of unauthorized approaches.

(e) Minimizing exposure of personnel.

(f) Blocking sight lines from vantage points.

(g) Orienting buildings to prevent adverse exposure.

(h) Providing barriers to unauthorized pedestrian and vehicle movement

(i) Mitigating weapons and explosives effects.

(j) Providing exterior electronic security systems.

(2) Vehicular Access. When an identified threat indicates vehicle control is necessary, access may be limited to specific entry control points. These control points may include the following.

(a) Gate and/or gatehouse, vehicle barriers, or a combination of the two.

(b) Adequate area to stack vehicles during search.

(c) Reduction in speed, distance, and reaction time determine the size of the vehicle barrier and location of the barrier.

(d) Design horizontal and vertical alignment of access drive to force speed reduction at the entry control point. Access drives and parking areas may need to be separated from facilities by sufficient distance to mitigate the identified threat of vehicle bombs.

(3) Site Features. In an area where there is an identified threat, topography and vegetation shall not obstruct views of the surrounding area.

(a) Topography, vegetation, and water may be used to accomplish the following.

1/ Slow movement towards exposed building facades.

2/ Limit exposure of pedestrian circulation.

3/ Block sight lines from vantage points.

(b) Perimeter walls may be used to mitigate blast effects. Determine the size, type and location of the wall.

o. Children's Outdoor Play Areas. Design the unsupervised children's outdoor play areas (as in family housing) to meet child safety in accordance with TM 5-803-11 (reference 3-23), Publication Number 325, US Consumer Product Safety Commission (CPSC) (reference 3-24), ASTM F 1292 (reference 3-25), ASTM F 1487 (reference 3-26), and ASTM PS-83 (reference 3-27). Design the play areas to provide developmental play by age group; and age appropriate play elements as defined in TM 5-803-11 (reference 3-23). The guidance for developing child development center children's outdoor play areas as a supervised play environment is provided in Appendix G and TM 5-663 (reference 3-28).

p. Outdoor Recreation and Sports Activities.

(1) Plan and design of outdoor recreation areas in accordance with TM 5-803-12 (reference 3-29).

(2) Layouts for most outdoor sports activities are provided in TM 5-803-10 (reference 3-30).

(3) Guidance for the design and layout of camping, picnicking, swimming areas and facilities for Army travel camps is provided in EM 1110-1-400 (reference 3-31) and TM 5-803-12 (reference 3-29).

q. Land Use Restrictions for Runway Clearances and Noise Abatement. Plan the runways to meet land use restrictions for runway clearances and noise abatement requirements discussed in Appendix K and TM 5-803-2 (reference 3-32).

r. Acceptable Noise Levels from Aircraft and Other Loud Noise Sources. Site facilities to meet the recommendations discussed in Appendix K and TM 5-803-2 (reference 3-32). Analyze the site to determine the requirements of the noise environment provided in the Installation Compatible Use Zone (ICUZ) Program, AR 200-1 (reference 3-33).

s. Siting of Ammunition and Explosives Facilities.

(1) General. Special guidelines apply to the design and siting of facilities that involve the handling, manufacture, storage, and transportation of hazardous materials, such as ammunition, explosives, chemicals, and liquid propellants. Site all facilities to meet the public safety requirements discussed in AR 385-63 (reference 3-34), AR 385-64 (reference 3-35) and TM 9-1300-206 (reference 3-36).

(2) DoD Explosive Safety Board (DDESB). The DDESB reviews site plans and facility designs for the construction or modification of ammunition and explosives facilities as required by AR 385-64 (reference 3-35).

t. Planning and Design in Floodplains or on Wetlands. To recognize the full value of floodplains and wetlands; and, to the extent possible, avoid adverse impacts that would result from activities in floodplains and on wetlands; apply the guidance in AR 200-1 (reference 3-33) and AR 415-15 (reference 3-14).

(1) Planning and Design Projects. Before conducting, supporting, or allowing an action in a wetland, floodplain or coastal zone, determine that this area is the only practical location for this action. Evaluate alternative sites and actions. Document the evaluations and meet the following actions.

(a) Minimize the destruction, degradation, or loss of floodplains and wetlands.

(b) Enhance and preserve the beneficial and natural values of floodplains and wetlands.

(c) Reduce the risk of flood loss and to minimize the impact of floods on human health, welfare, and safety.

(2) Definitions.

(a) Wetlands. Wetlands are areas that are inundated by ground or surface water with a frequency to support, and under normal circumstances does or would support, a prevalence of aquatic or vegetative life that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include bogs, flats, marshes, natural ponds, swamps, and similar areas such as potholes, river outflows, sloughs, and wet meadows. Wetlands may be, but are not necessarily located in floodplains.

(b) Floodplains. Floodplains are lowland and relatively flat areas adjoining coastal and inland waters including flood prone areas of offshore islands; and at a minimum, areas subject to one percent or greater chance of flooding in any given year (the 100-year flood). For critical facilities such as, but not limited to, hazardous chemicals or wastes, fuel storage, or hospitals where evacuation of patients would be difficult, the floodplain is the area subject to a 0.2% or greater chance of flooding in any given year (500-year flood).

(c) Floodway. The floodway is the area defined as the area consisting of the stream channel and the over bank areas required to convey the 100-year flood without flood heights or velocities increasing to exceed stated levels. Avoid development in the floodway areas. Similar areas in the coastal floodplains are referred to as "coastal high hazard areas." Avoid development in these areas.

(d) Coastal Zone Management (CZM). Coordinate projects with regional, state, or local CZM plans in accordance with AR 420-74 (reference 3-11) and AR 210-70 **\4\(reference 3-37)/4/**. All Army installations, facilities, and lands under direct Army control, and all lands leased for use by Army components are excluded from mandatory compliance with the CZM plan of the coastal state. Provide actions effecting a coastal zone consistent with the approved program of the coastal state.

(e) Planning, Design; and Substantial Rehabilitation or Modification Projects. This phrase includes channeling, diking, draining, dredging, impounding, filling, and related activities in addition to facilities and structures.

(3) Environmental Assessment. When the wetland, floodplain, floodway, or coastal zone remains the only practical location (after all alternatives have been studied) design or modify the project to minimize harm to the area in accordance with AR 210-20 (reference 3-10) and AR 200-1 (reference 3-33). Prepare an environmental assessment in accordance with AR 200-2 (reference 3-3).

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3-26 ASTM F 1487, Standard Consumer Safety Performance Specification for Playground Equipment for Public Use, August 1997

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