Utilities Systems Planning Bulletin

Prepared for: U.S. Air Force Directorate of Engineering and Services and
Dept. of the Army HQ U.S. Army Corps of Engineers

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Introduction

CHAPTER 1

INTRODUCTION

A. PURPOSE OF THE BULLETIN/MANUAL

1-1. The purpose of this Bulletin/Manual is to provide the community planner with a framework for defining and then incorporating the utilities systems needs into the development and implementation of near-term and long-term planning, design, installation and construction programs. The bulletin/manual explains the concept of utilities systems planning and describes a process for developing, submitting for approval, implementing and updating the utilities systems plan component of Base/Installation comprehensive Plans. Figure I-I shows where utilities systems planning falls in relation to the other component plans prepared as part of the Base/Installation comprehensive Planning Process. The Bulletin/Manual is prepared in the context of the Base comprehensive Plan (USAF) and the Installation comprehensive Plan (USA), hereafter referred to as The Plan. The expressed Army and Air Force goals of these documents are to:

1) Provide effective and efficient use of installation resources to support the mission.

2) Direct the long-range development of the installation.

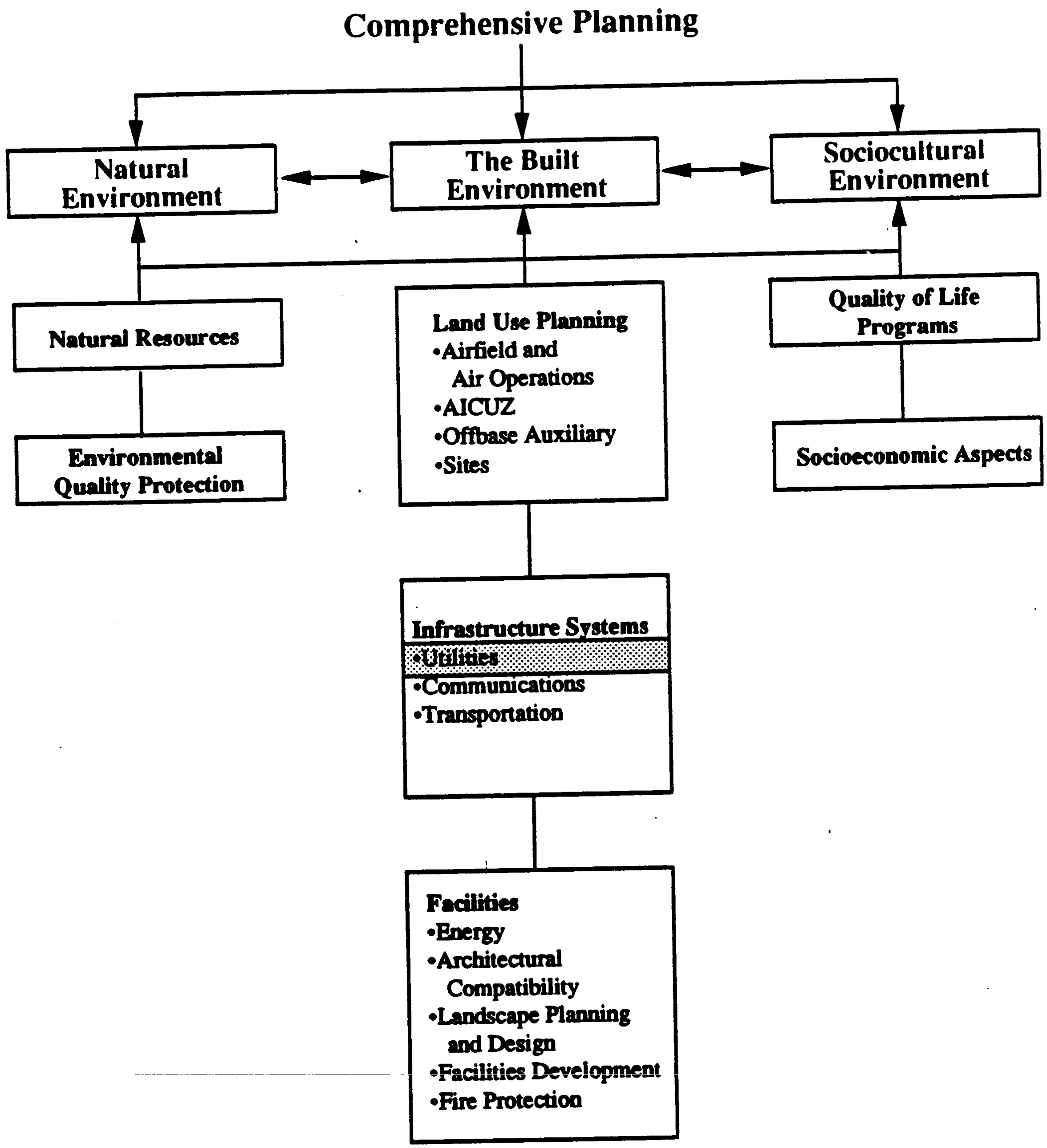
3) Integrate a number of interrelated functional programs derived from other component plans of The Plan.

4) Relate mission planning to policies, programs and specific projects for on installation facilities systems.

5) Relate the needs of the installation to the social, cultural and economic aspects of the surrounding civilian community.

6) Provide the basis for all decisions on siting of facilities and setting priorities and setting priorities and preparation of the Five-Year Defense Program (FYDP) and other capital improvement programs, and long-range facilities renovations and replacements.

7) Make optimal use of the latest developments in energy efficient concepts/systems! technologies.


Comprehensive Planning
Natural Environment
The Built Environment
Sociocultural Environment
Natural Resources
Environmental Quality Protection
Land Use Planning
•Airfield and Air Operations
•AICUZ
•Offbase Auxiliary
•Sites
Quality of Life Programs
Socioeconomic Aspects
Infrastructure Systems
•Utilities
•Communications
•Transportation
Facilities
•Energy
•Architectural Compatibility
•Landscape Planning and Design
•Facilities Development
•Fire Protection

8) Protect the natural and human environment.

9) Provide the highest possible quality of life for the Air Force/Army community.

B. HOW TO USE THE BULLETIN/MANUAL

1-2. Content. The Utilities Systems Planning Bulletin/Manual is one of a series of documents serving the U.S. Air Force's and U.S. Army's planning process. It is a resource document for installation planners who recommend or plan near-term and long-term improvements at their installations. The bulletin/manual contains utilities systems planning principles and methodologies for the basic seven utilities systems including:

- Water supply
- Wastewater system
    - Sanitary sewer
    - Industrial wastewater
    - Storm drainage
- Electrical distribution system
- Central heating and cooling
- Natural gas system
- Liquid fuels system
- Central aircraft support

Communications systems planning is covered in a separate bulletin/manual.

1-3. Terminology. Non-specific military terms have been used wherever possible in this document. In some case, generic terms were devised to avoid using terms specific to the Army or Air Force. Please refer to the table below for the specific Army and Air Force definitions of these generic terms.

Generic	Army	Air Force
installation	post	base
the Plan (product)	the Installation Comprehensive Plan	the Base Comprehensive Plan (BCP)
the planner	master planner	community planner

Comprehensive planning (process)	installation comprehensive planning	Base Comprehensive Planning
the engineer	Directorate of Engineering and Housing	Base Civil Engineer (BCE)
major command	MACOM	MAJCOM

1-4. The format follows each step of the planning process. Therefore, the planner may start at the most appropriate section in the Bulletin/Manual, given the status of the program. A detailed Table of Contents serves as an index to individual topics. Throughout the bulletin manual there are practical examples of utilities planning principles applied to the specific needs on Air Force and Army installations. The planner can use the bulletin/manual as a reference guide in several ways.

1) Help with day-to-day activities

   Steps:

   a) Read Chapter 1.

   b) Read Chapter Z Section C.

   c) Examine Chapter 3 to determine the utilities framework

   d) Read the alternative actions throughout Chapter 4.

   e) Read Chapters 5 and 6 to determine appropriate ways to evaluate and implement utility improvements

2) Produce utilities systems plan using installation personnel.

   <u>Steps</u>:

   a) Read Chapter 1.

   b) Read Appendix A - Sample Scope of Work.

   c) Read Chapters 2 through 6 in order to understand planning process and actions.

   d) Reread Chapters as needed during plan preparation.

3) Produce utilities systems plan with consultant assistance.

<u>Steps</u>:

a) Read Chapter 1.

b) Read Appendix A - Sample Scope of Work.

c) Read Chapters 2 and 3 to determine study goals/objectives, inventory needs, problems and opportunities, and necessary forecasting and analysis techniques. Assess capabilities of personnel and decide appropriate role for consultant.

d) Read Chapters 4, 5, and 6 in enough detail to permit review of the consultant products.

1-5. Bulletin/Manual format. Topically, the Bulletin/Manual is organized as follows:

a. **Chapter 1. Introduction.** The Introduction describes the function of The Plan and incorporation of the 10 utilities systems into the planning process.

b. **Chapter 2. Goals And Objectives and Current Inventory.** This chapter presents the overall goals and objectives of the planning process and specific utilities planning objectives. The approach to obtaining and assessing data is presented along with a description of the characteristics of the 10 utilities systems.

c. **Chapter 3. Forecasting and Analysis.** This chapter addresses opportunities and constraints as well as the process for forecasting and analyzing future requirements.

d. **Chapter 4. Alternative Plan Development.** This chapter discusses methods of categorizing the alternatives for each of the utilities systems.

e. **Chapter 5. Evaluation and Recommendation.** This chapter discuses methods for evaluating alternatives through the use of both technical and non-technical criteria and the process for recommending a preferred alternative(s).

f. **Chapter 6. Implementing and Monitoring the Utilities Systems Plan.** This chapter focuses on the implementation and monitoring process. Coordination of the Utilities Systems Plan with the other component plans of the Plan is also discussed.

g. **Appendices.**

C. WHAT IS UTILITIES SYSTEMS PLANNING?

1-6. The Concept

a. Planning consists of the orderly development of policies, programs and plans to guide improvements and change.

b. Utilities systems planning is a critical component of the comprehensive planning process in that it provides the means to determine how to provide or improve services such as water, sewer, electricity and gas, to people and installation activities that are critical to mission accomplishment and quality of life. Without a utilities systems plan to support current and future land use planning or long range facilities development, critical mission functions could be compromised due to delayed or inadequate utilities. Additionally, late or inadequate planning could result in unnecessary expenditures. For example, the placement of a housing complex in a remote location on an installation would require new roads and utilities services to be brought in at substantial costs.

c. Utilities systems planning is generally responsive in nature. For example, land use planning and facility programming often precede development of the utilities systems plan. The Utilities Systems Plan sets forth the potential system alternatives that respond to these existing, planned and future needs of the installation.

Utilities systems planning is responsive in nature.

D. UTILITIES SYSTEMS PLAN AS A COMPONENT OF THE PLAN

1-7. The Application

a. Through effective utilities systems planning, the quality, reliability, capacity and maintainability of the utilities systems can be improved. Provision for clean and efficient services can be made using both community, installation, or a combination of community and installation facilities.

b. It is imperative that the Utilities Systems Plan is consistent with other components of the The Plan. Although it is primarily an outgrowth of these other plans, utilities systems planning also **"feeds back"** into the modification and refinement of these other elements (Figure 1-2). The most relevant component plans to the Utilities Systems Plan are described in the next section.

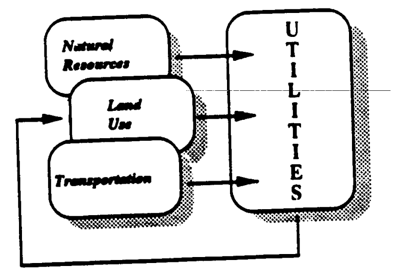


Figure 1-2

1-8. Relationship to other Component Plans

a. The Land Use Plan denotes existing and planned functional areas on the installation regarding the mission assessments. This pattern is key to determining the utilities demands and requirements of the installation. Each land use alternative will require a distribution network of utilities to service the functional needs established by the land use plan. Likewise utilities considerations may determine the appropriateness of certain land use patterns.

b. The Land Use Plan identifies land areas for all land uses currently on the installation and those likely to be needed within the planning timeframe. The Utilities Systems Plan must be developed in concert with these proposals. For example, these future facilities will require the full range of utilities, therefore, provisions for the appropriate connections and distribution networks must be incorporated into the land use philosophy. Realizing that future land use and utilities systems needs may be very different from those that currently exist requires considerable visionary thinking (Figure 1-3).

c. The Natural Resource Plan shows the present use of undeveloped land and major constraints such as soil capabilities, floodplains and other unique natural areas that must be considered in developing the utilities plan (Figure 1-3).

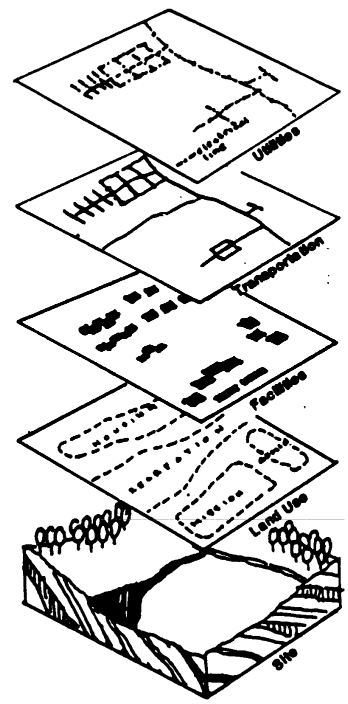


Figure 1-3

d. The Transportation Plan is used to determine the means to provide for safe and efficient movement of people and goods. Generally, this plan is developed according to the land use requirements and often serves as the basis for utility distribution planning (Figure 1-4). It is essential, therefore, that the transportation, land use, and utilities plans be considered in unison when considering future needs.

e. The Long Range Facilities Development Plan is the primary means to ensure that future new construction and the use and renovation of existing facilities and systems match the I-and Use Plan. The Long Range Facilities Development Plan shows all relocations of activities into new or renovated facilities, expected demolition and replacement. It is also a pre-design plan that establishes roadways and parking, as well as utility alignments.

f. The Energy Plan is used to ensure that programs underway comply with the energy consumption goals for the installation. Consideration of energy conservation must be given in developing the Utilities Systems Plan.

g. Communications and environmental quality protection plans also provide a context for utilities systems planning and should therefore be closely coordinated.

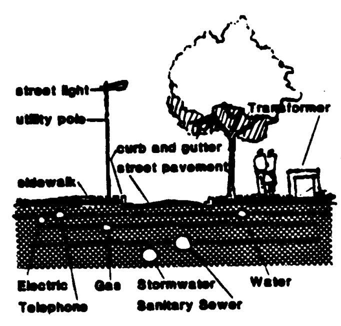


Figure 1-4

1-9. Maps and Plans

a. A major product of the utilities systems planning process is a series of systems plan maps. These maps show the various utilities systems on the installation as well as establish the framework for future planning. These maps are contained in the AF Tab G series and in the Army existing conditions maps. More detailed descriptions of these maps are contained in Appendix C.

b. A digital comprehensive plan mapping system has been created for the purpose of providing automated mapping and facilities management. This is the result of incorporating many of the best methodologies found in government contract manuals. The objective is to strike a balance between data flexibility and production time. By instituting this system, both short-term and long-term efficiencies are gained by contractors and the Air Force/Army.

E. PHYSICAL SECURITY AND ANTITERRORISM

1-10. Contingency Planning

a. Contingency planning is an essential element of the Plan. A separate bulletin/manual has been prepared that covers the issues related to combat effectiveness and contingency planning. The Utilities Systems Plan, along with those of I-and Use and Transportation in particular, are key components which must reflect combat readiness capability in their recommendations for installation development.

b. Although it is not possible to protect an installation against all possible emergencies all of the time, many improvements can be made through the arrangement of land uses, the routing of transportation and utility systems, and the location, orientation and design of facilities to reduce their vulnerability to outside threats. The most effective and least costly protective measures are those incorporated during plan development, project site selection and facility design.

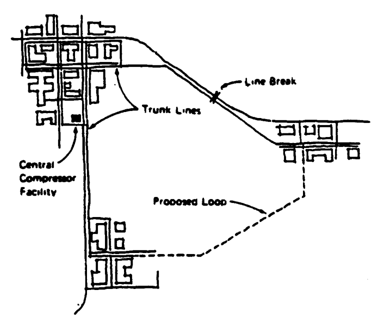
c. Where physical protection is a concern at existing facilities, cost effective measures need to be developed in concert with the facility users. Although retrofitted protective measures are often less effective than those incorporated during project design, the use of screening, barrier placement, changes in vehicle access and parking, and rearrangement of interior functions can enhance physical protection.

d. High security areas (such as satellite communications sites and command, control, communications and intelligence facilities) should be kept as small as possible and away from the installation perimeter (but not located in predicted, high potential primary target areas). By limiting their size, restrictive access requirements will have less impact on the total installation. In addition, small areas with simple boundary configurations will require fewer perimeter improvements (less fencing, shorter patrol routes, and fewer perimeter lights).

1-11. Utilities Systems Security

a. Mission accomplishment is heavily reliant on installation utilities, particularly water and electricity. Dependence on insecure utilities systems, such as exposed pipelines, overhead electrical distribution, and off-base water and energy supplies, make the mission highly vulnerable to disruption by terrorists, saboteurs, or disasters.

b. Planning utilities systems should consider survivability and reliability. In high threat areas, utilities need to be redundant, (underground when cost effective), dispersed and/or looped (as shown in Figure 1-5) to enhance operability if damage (deliberate or accidental) occurs. I-ping utility systems and providing the capability to isolate sections and runs of lines also helps in day-to-day maintenance and repair minimizing total outage times or even the need for outages while maintenance procedures are underway.



Utility System Redundancy
Figure 1-5

c. Among the highest value targets on the installation are fuel storage sites and distribution systems. Similar to weapons storage areas in their peacetime and wartime vulnerabilities, they are critical to the mission, and present a major safety hazard to the installation. In this regard, the land use and utilities systems planning efforts must be coordinated to achieve security goals and objectives. For example, fuel storage sites and associated handling facilities should be separated from all other potential targets. To limit adverse impacts due to a fuel spill resulting from a breached containment berm, fuel storage tanks and bladders should be located down-slope from other installation areas. Because fuel storage tanks have unique visual profiles, they should be concealed and dispersed if possible. The entire fuel distribution system, including pipes, valves, controls, pumps and generators, should be hardened to the same level. At a minimum, above-ground valves and pipes should be provided splinter protection.

F. WHO IS INVOLVED?

1-12. The Coordination

a. Because of the inclusive nature of the utilities planning function, close cooperation is necessary between planning and other disciplines. Utilities planning at an installation is a coordinated effort involving the community planner, the engineers in the Base Civil Engineer (BCE)/Directorate of Engineering and Housing (DEH), the Environmental Directorate (EM), the installation programmers, and, frequently, outside consultants. Input from local public works agencies (the water, sewer and power companies; citizens; and fire department and tenants) is also essential.

PLANNING: Systems requirements and coordination

b. The distinction between utilities systems planning and engineering is an important one. Planning consists of an understanding of systems needs and available technologies.

Engineering entails more detailed analysis and design and specification of individual utility systems. The planner obtains, coordinates and consolidates information and input from sources both inside and outside the immediate task (such as the land use plan). The engineer has the technical experience and knowledge that must be considered to ensure the utilities systems plan is reliable and realistic in its recommendations. The engineer role can be either part of the installation's BCE/DEH or can be contracted for through a civilian consultant and managed by the installation Engineer. (Assistance is also available through the Corps of Engineers Districts and MACOM/MAJCOM.

ENGINEERING: Systems analysis and design

c. A team approach between planners, engineers and programmers will be required to identify and validate problems, evaluate alternative solutions, prepare cost-effective recommendations, and implement a long-range plan. Within each step of the utilities planning process, described in the following section, there will be specific roles for each discipline.

G. THE UTILITIES SYSTEMS PLANNING PROCESS

1-13. The Planning Process. Planning is a rational decision-making sequence that attempts to direct activities and actions toward agreed-upon goals and objectives The utilities systems planning process can be developed as a three step operation consisting of identification, evaluation, implementation, and monitoring (Figure 1-6).

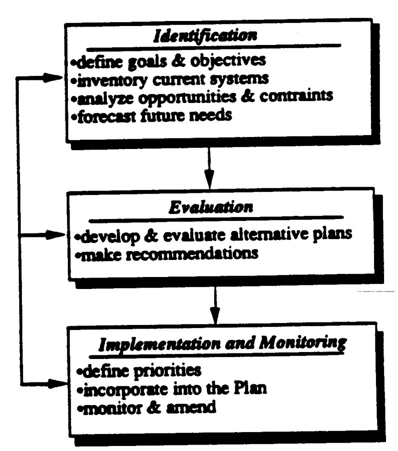


Figure 1-6

a. **Identification** - In this phase, the engineer or engineering consultant takes the lead in:

- Defining the goals and objectives for the delivery of utilities systems, and
- Inventoring the current systems to determine their adequacy in providing for existing and future requirements.

- Analyze opportunities and constraints.
- Forecast future needs.
- Coordinate utilities systems planning with other component plans.

b. **Evaluation and Recommendation** - The planner and the engineer work jointly in this phase to:

- Develop and evaluate alternative plans and methods that lead sequentially to the stated objectives.
- Decide on recommended approaches.

c. **Implementation and Monitoring** - In this phase, implementation of the plan is turned over to the programmer which includes:

- Defining the methods of achieving the recommended approach.
- The engineer and planner continually monitor and update the utilities system plan as conditions change and improvements are made.

H. THE INSTALLATION AND COMMUNITY

1-14. A Joint Effort

a. The utilities systems planning process must relate to the needs of both the installation and the community. Most installations are located adjacent to communities where public services, such as water, sewer, electrical power, and natural resources are at least partially available. Most installations depend on these communities for their services (Figure 1-7). The greater the number of people employed at the installation and the higher the percentage of personnel residing off-installation, the greater the interdependence between community and installation. Often the installation and community have common problems relating to land use, transportation or utilities services. Careful coordination is necessary in that new development both on the installation or in the community can result in more demand on services or can divert the

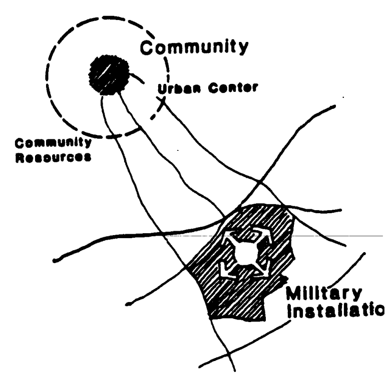


Figure 1-7

available supply from one area to another with negative results. Security considerations must also be accounted for in the development of such agreements and decisions related to the use of community services.

b. In most communities, the utilities systems extend radially from the core. Such a network serves the central business districts well, but is often less likely to meet military installation demand. This is due in part to the fact that many installations are situated on the periphery of the community where utility lines have not yet been extended. A desirable utilities plan for an installation is one that provides the necessary services without overburdening the community supply.

c. When services are not available from the community (or other municipal sources), the installation must provide for an internal utility source to support its overall mission. Therefore, coordination with the community is key to all utilities planning efforts.

1) At What point does planner consult community representatives?

The earlier the planner can initiate contact the better. As in the military, community capital improvement plans are normally prepared years in advance in order to plan for the capital needed to replace or upgrade inadequate and obsolete facilities (for example, a new sewage treatment plant).

Contact community representatives as early as possible.

2) Who are the appropriate community representatives and the departments to contact?

This varies with each community (municipality), depending on whether it is incorporated, a city, a borough or a district The engineer on the installation should be able to provide the points of contact to the community planner for the various utilities systems.

See Installation Engineer for appropriate

2

Goals, Objectives & Current Inventory

CHAPTER 2

GOALS AND OBJECTIVES AND CURRENT INVENTORY

A. GOALS AND OBJECTIVES

2-1. Getting Started

a. Before the utilities systems plan component can be prepared, the planners must establish a starting point (Figure 2-1). The first step is to identify appropriate goals and objectives for improving utilities conditions. **These goals and objectives must be consistent with those of the overall Base(Installation Comprehensive Plan (The Plan) for the installation as well as those of the land use, natural resources, and transportation plans on which it will be based.**

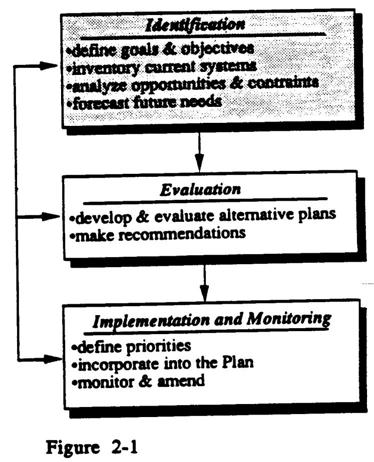


Figure 2-1

b. In order to begin this process, an inventory of current conditions must be prepared or gathered. The inventory should include all existing utility maps and records, roadway plans, land uses, and socio-economic characteristics of the installation and community surrounding the installation. The purpose of the inventory is to identify the scope and nature of the systems, identify problems that exist and establish a base of information from which to develop a plan to satisfy future conditions.

B. GOALS OF THE PLAN

2-2. Purpose

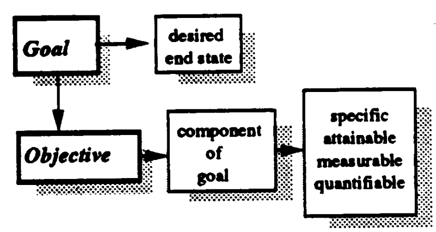
a. The primary purpose of the comprehensive planning process is to support and enhance the operational mission of the installation. This is accomplished by providing a plan that constitutes the framework for programming, design, and construction of facilities and structures. In the short run, the process links mission planning to developing policies, programs, and specific projects for facilities and systems. In the long run, the overall development of the installation including the types and siting of facilities is guided by The Plan.

b. Goals have been developed for the comprehensive planning process by both the Air Force and the Army. The general content of these goals are outlined below.

- Effective, orderly direction of the long-range development of the installation.
- A comprehensive procedure for relating mission planning to policies, programs, and specific projects for installation facilities and systems.
- A framework for integrating coherently the different component plans of The Plan.
- A complementary and harmonious relationship between the installation and the community, brought about and maintained through cooperative community planning.
- Provision of the basis for developing a capital improvement plan, including guidelines for the siting of facilities.
- Wise protection, use, and management of resources from the natural, built, and sociocultural environments.
- The highest possible quality of life for the Air Force and Army community.

C. UTILITIES SYSTEMS PLANNING GOALS AND OBJECTIVES

2-3. Definition



a. The development of the utilities systems plan will be guided by the statement of goals and objectives developed during the first part of the identification phase (Figure 2-2). The importance of developing a well-conceived set of goals and objectives cannot be overemphasized. The unique mission of each installation tenants on the installation and characteristics of its built and natural environments require a certain degree of customization of its utilities goals and objectives.

D. INVENTORY AND DATA COLLECTION

2-4. Methods of Analysis

a. The objective of utilities systems planning is to assure that installation-wide utilities systems are of adequate capacity to serve existing and future development, and are optimal in terms of maintainability and life-cycle costing. An analysis of existing demand, capacities, loading and possible deficiencies in the plants and distribution systems serving the installation must be reviewed. A complete inventory of existing utilities systems and related conditions is necessary in order to prepare a utilities systems plan.

A complete inventory is required

b. It is necessary to define and coordinate the inventory effort between the various utilities planning participants. Largely, the installation engineer will be in the lead in this regard. Most of the information and expertise is contained within the BCE/DEH function.

Inventory includes:

- ***Reports and studies***
- ***Public works and power and company information***
- ***Field observations***
- ***Interviews***

c. Nevertheless, all potential sources for obtaining data should be explored in order to confirm information from the primary source, or to supplement information not included in other sources.

- The initial source of existing utility information should be the utilities systems maps available at the installation. These data are probably the most important documentation of existing conditions. The maps contain the type, size and location of all existing utilities that are above or below grade at the installation. As built drawings should also be included as an existing source of utilities information.

- Often there have been reports and studies that apply to specific utilities prepared for installations. These are valuable tools for defining conditions and alternatives. A completed utilities report can be an extremely useful tool in the inventory process.

- Public works and power company maps and drawings should be obtained to determine the sources and conditions outside the installation. Often, consumption rates and capacities of the utilities are available through these outside sources.

- Field verifications should be made to assure that conditions shown on maps and reports are factual and to reveal information that may not have been shown on the maps that may expand on the existing data base.

- Finally, interviews with other technical experts on the installation, fire department personnel, municipal public works engineer, security officer, power and water company representatives should be conducted to assure that a complete inventory has been compiled. Shop personnel are key to identifying utilities systems components. Shop personnel may provide the most reliable information concerning pipe sizes, location, depth or type of material.

E. SYSTEMS CHARACTERISTICS

2-5. The Inventory

a. The utilities systems inventory includes water (potable and non-potable), wastewater (sanitary sewer, industrial wastewater, storm drainage), electrical, central heating and cooling, natural gas, liquid fuels and, at some installations, central aircraft support systems. The data that are to be collected on existing utility services win vary according to the nature of the utility. The systems characteristics and required data for individual components of the utilities Plan are detailed in the following sections

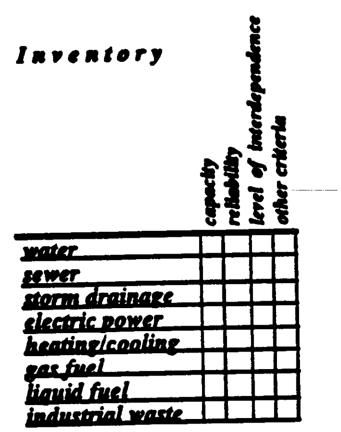


Figure 2-3

b. Generally, the data to be collected should address capacity, reliability and the level of interdependence (inside-outside "the fence"). (Figure 2-3).

2-6. Water System

a. A water system that will be adequate for the military mission will have to provide a distribution of water mains for both domestic water consumption, light industrial use and fire protection. The location and source of water should be selected to give maximum protection against inadvertent and internal contamination. A complete water system includes consideration of the source, mechanical equipment, distribution and storage. Based on a cluster of buildings on the installation, demand can be identified and tabulated by quadrant or region These data are obtained by the Engineer from pumpage records at the pump stations, water meters and flow charts. An important element in determining demand for water is the ability to provide water for fire flow. The "design fire flow" is based on meeting the largest demand generated by a single building on fire. The yearly demand for fire flow is very low, the maximum day demand is high. Fire flow demand is added to normal consumption.

b. **Sources of Water Supply.** There are three potential sources of water typically available to an installation. Preferably two independent sources, each capable of supply at the maximum day demand rate, should be used

Sources of water supply include:

- ***Municipal service***
- ***Ground water***
- ***Rivers, lakes, reservoirs***

1) **Municipal Source.** Where utilities security and readiness is not an issue, the primary source of water would usually be the municipal service, which supplies the entire region. Data on allowable rates, capacity of the system to deliver pressure, ratings, location of mains, and contractors agreements between the installation and the supplier, are collected as part of the inventory by the Engineer.

2) **Ground Water.** A primary source of water considered as a back-up to municipal service or a source in regions where municipal service is not available or economical is ground or sub-surface water. Ground water is taken from beneath the surface by means of wells, or underground springs. The Engineer should be familiar with the current status of the wells and any potential contamination issues on the installation. Data pertinent to the inventory includes:

- Location of wells
- Age and condition of wells
- Depth of wells
- Quality of groundwater
- Diameter of wells
- Depth of water in wells
- Type of pump in wells
- Yield of wells

3) **Surface Sources.** Rivers, lakes and reservoirs are another source of water supply. Preferably they should be located within the installation for security reasons, however, practically this is not always possible. Surface sources require special intake structures which draw out the water and treatment plants to remove contaminants found in surface waters.

Considerations should be given to the location of intake structures to maximize their efficiency and water quality.

- Isolate from inhabitated areas where pollution may occur.

- Locate upstream or upcurrent from industrial area

- Assume water is of sufficient depth to preclude freezing.

c. **Pumps.** Within a distribution system, it is generally necessary to raise water level at one or more points in the system and to keep pressure at a desirable height. Generally pumps are needed for the following reasons:

- Draw water from the source to the reservoir or treatment plant.

- Lift the water into elevated storage tanks.
- Provide required pressures throughout the distribution system.

1) Factors affecting pumping requirements include:

    - Availability of gravity distribution if the source of supply is at an elevation above the installation so that sufficient pressure can be maintained when little or no pumping is required.
    - Capacity of storage tanks. When gravity is not available and storage is minimal, there is a greater need for higher output (pressure) pumps for fire demand.

d. **Pumping Stations.** Pumping stations are buildings which contain pumps and other equipment needed for proper water distribution. Location of the pumping stations is important to assure proper pressure is maintained. A central location for the pump station is generally preferred, although placement of the station on one side of the high-use area and elevated storage tank on the other allows desired results. If the station uses steam to drive the pumps, locating the station along side railroad spurs delivering coal or other fuel should be considered.

e. **Storage Tanks and Reservoirs**

1) Because the demand for water is never constant and because the pressure requirements for fire flow are higher than normal flow, there is typically a need to store or contain water until a need for it arises.

2) Storage tanks are generally elevated steel or concrete structures where treated water, ready for human consumption, is impounded. The elevation of the water is important in fulfilling the pressure requirements needed in the system. Tanks should be centrally located or evenly distributed to equalize the pressures.

3) Reservoirs or basins are impounding ponds where water is stored prior to treatment. Reservoirs are generally built of earth, concrete or masonry. If the reservoir is containing potable water, ideally the basin should be covered. Also careful consideration should be given to the location of the basin so that contamination is eliminated. It should be located so flood waters do not enter the basin through drain pipes bringing with them contaminating subsurfaces.

Height is a locational constraint for raised water storage tanks.

4) There arc constraints regarding the location of these structures given their height. For example, they should not be in the ICUZ/AICUZ. Capacities depend on the characteristics of the system and the demand requirements for routine use and emergency situations. Data pertinent to storage tanks includes:

- Security of location
- Location of tank
- Height of tank
- Year (tanks) installed (age of tank)
- Capacity of tank
- Overflow elevation
- Physical condition of tank and support structure
- Cathodic protection system

f. **Distribution System (Figure 2-4)**

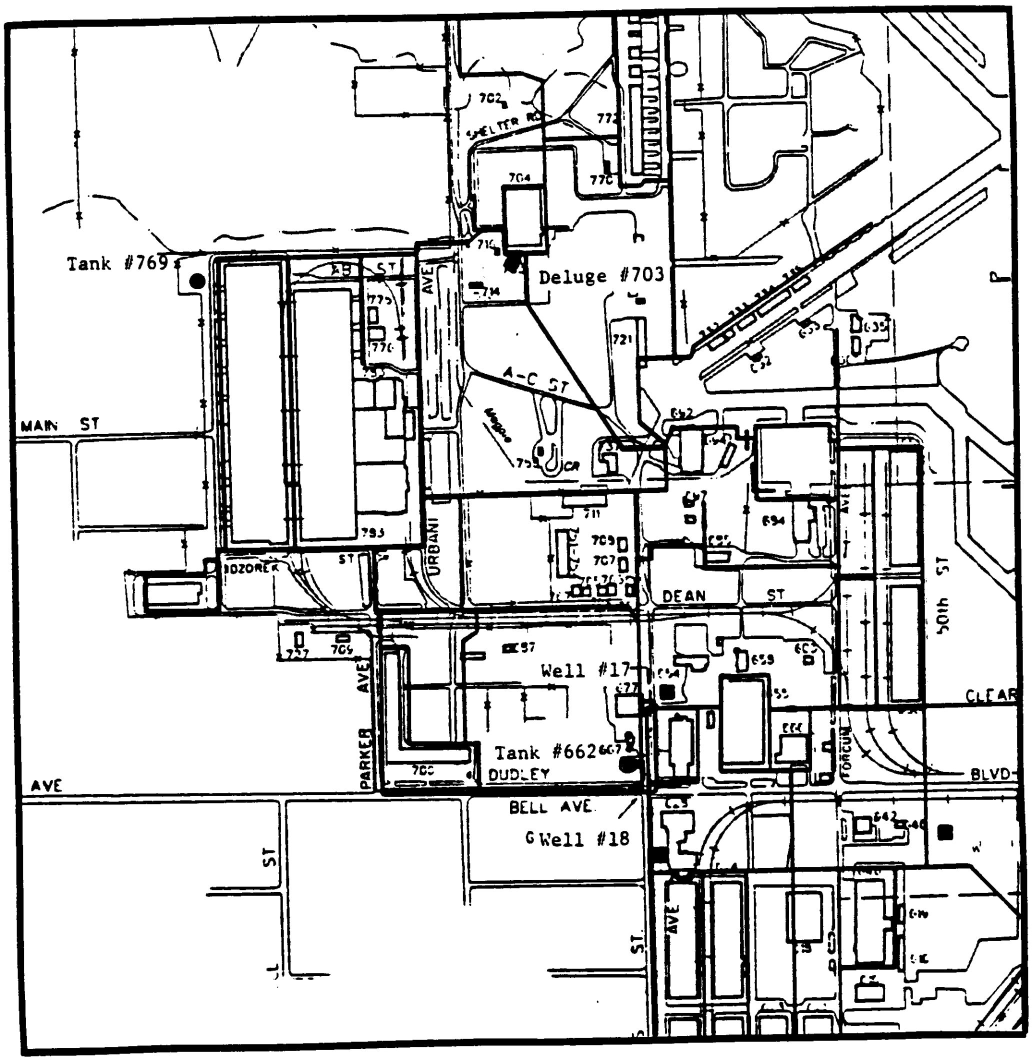
1) Primary feeders are the backbone of the distribution system. They carry large quantities of water from the pump station to storage tanks, and all are as to be served.

2) Secondary feeders carry large amounts of water from the primary feeders to smaller areas. They form loops from one primary to another. Service mains from these secondary feeders form a grid over the area to be serviced and supply water to fire hydrants and service pipes of housing areas and other buildings.

3) The importance of valves is often overlooked, both in design of a new system and extensions of existing systems. A sufficient number of properly located valves is a necessity for proper isolation of the various pipe line segments. Their location is

Water Distribution System
Ft. Alpha/Hometown AFB

Figure 2-4



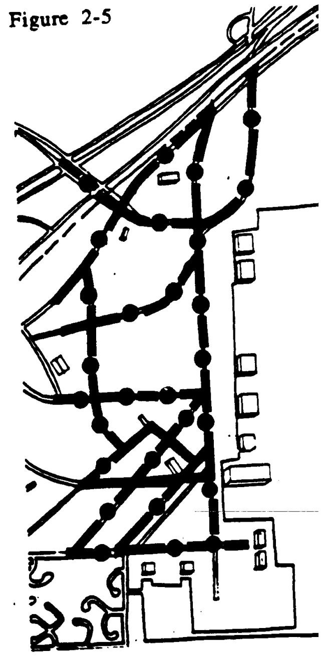
LEGEND:

—— **Major Water Line**

primarily influenced by site conditions. Elements of the distribution system inventory include (Figure 2-5):

- Location of water pipes
- Diameter of pipes
- Diameter of pipes
- Location of fire hydrants
- Location of valves (sectional and shut off)
- Valve test dates

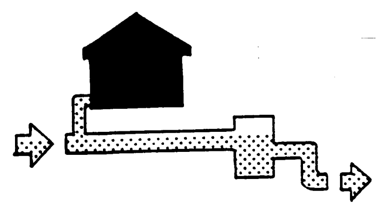
Figure 2-5



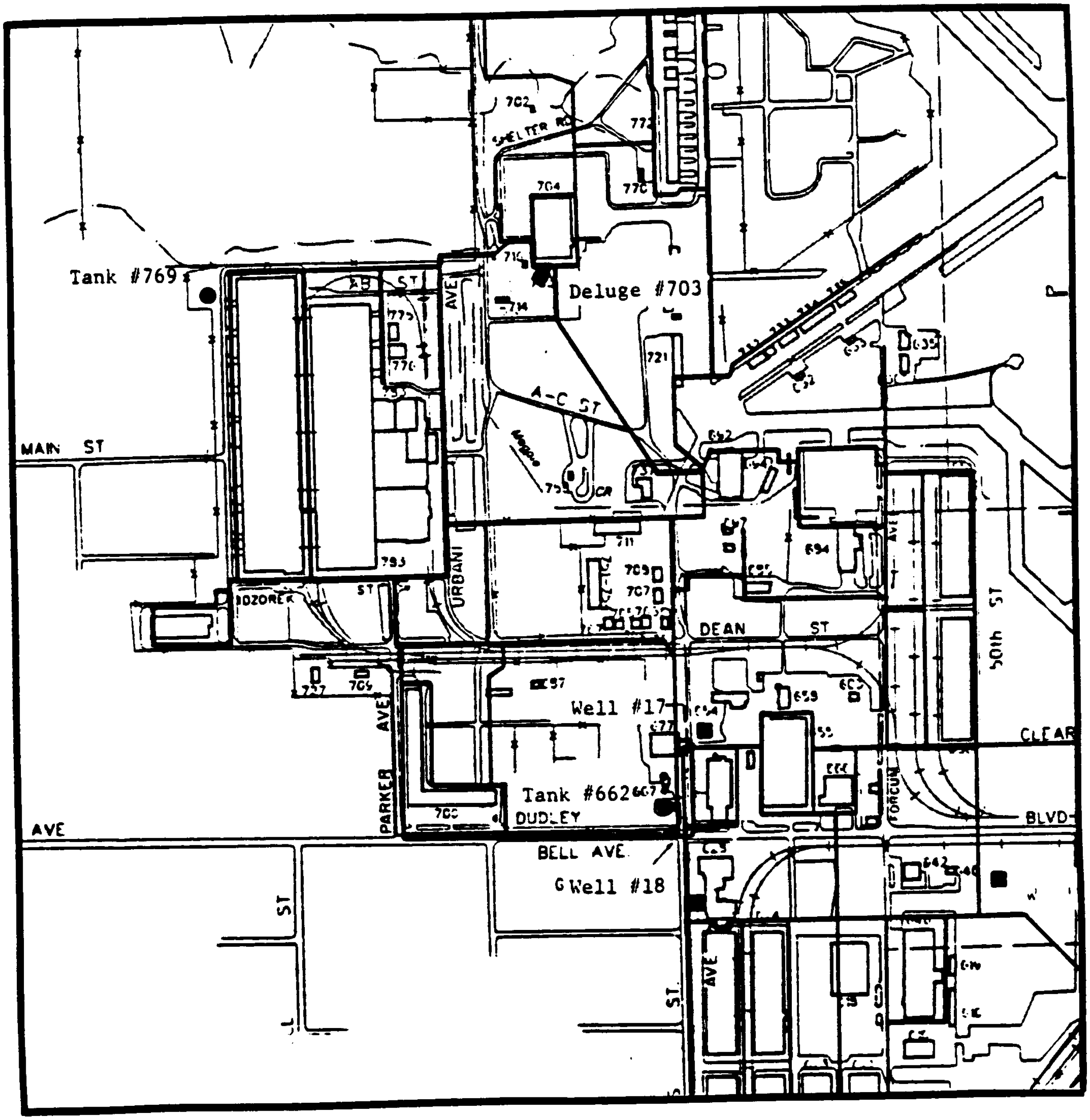
2-7. Non-potable water is water that is unsafe for drinking, or for other domestic uses. It is generally available from surface sources such as ponds and rivers without the benefit of treatment. In locations where there is a need to conserve drinking water or potable water, non-potable water is an alternative to use for irrigation for lawns and gardens, and industrial uses where the water might only be used as a flushing agent. Again, sensitivity to existing contamination issues must be determined.

2-8. Wastewater System - Sanitary Sewer

a. Adequate sewage collection, transmission and treatment are essential for the health and safety of the installation personnel and the community at large. It is also necessary to accommodate the future development of the installation. Sewage is the wastewater conveyed by a conduit known as a sewer. Sanitary sewage originates in sanitary conveniences of homes, shops and offices. The treatment of sewage is an artificial process that removes harmful agents from the water caring the waste. Disposal is the process of carrying away the materials either with or without treatment. The sewer system must be adequate in size or it will overflow and cause property damage, danger to health, and nuisances (Figure 2-6).



b. Flow Characteristics. Historic data for the various flows should be obtained by the installation engineer, the municipal public work's engineer, or the wastewater disposal agency serving the installation. Population data, available from manpower resource statements, can be used to show military growth trends that could



LEGEND:

—— Major Water Line

result in increased/decreased flows or existing deficiencies. Environmental impacts/factors must also be considered.

c. System Components**.** Identification of the existing sanitary sewer begins with an inventory of the components of the system. Typically, there are two methods of conveying sewage: 1) **separate sewers** and 2) **combined sewers**. In a separate sewer, the sanitary sewage and storm sewage are carried separately in their own conduits. Combined sewer systems, carry both domestic and storm sewage in a single point. Today, construction of sewers is confined to separate systems, however, combined systems are commonly used in older facilities. Utility maps obtained/produced by the Engineer should be used to locate sewer lines, manholes, pump stations and treatment facilities. Infiltration and inflow sources into the sewers should be identified to determine the actual flow characteristics of the system. Location is also critical. Attempts should be made to have the sanitary sewer be gravity driven whenever the topography is suitable. Where combined sewers still exist, efforts should be directed towards eliminating them whenever possible.

d. Coordination with the adjacent community is particularly important with respect to sewage and sewage treatment. Many installations rely on the community's capacity. In this respect, it will be important to determine the existing conditions and future plans of the community so that its supply will not be overburdened.

2-9. Wastewater System - Industrial

a. One of the by-products of the modern military installation are the industrial processes that support the overall mission. Fabrication shops, repair shops, overhaul shops, depot facilities, printing shops, food services and medical services are examples of the diversified activities that can be expected to exist on an installation. Any or all of these industries can produce contaminants that are beyond the capabilities of normal sanitary sewage treatment (Table 2-1).

Table 2-1
INDUSTRIAL WASTE

Industry	Product	Waste Product
Fabrication and Manufacture Repair Shops	Machine Shops Motor Pool Engine Shop	Chemical solvents, resins tar, resins solvents, oil, gasoline engine fluids
Paint Shops	Paint	Paints and solvents, dye
Laundry	Cleaners	Shops, bleach, rinse water
Food Services	Dairy, Mess Hall, Commissary	Organic waste, milk product
Medical Services	Hospital Clinic, Veterinarian	Phenol
Printing	Newspaper, Publishing	Ink

b. Normal biological treatment of industrial waste is not always adequate in cleansing the wash water. Special procedures may be required to neutralize or screen the industrial waste before it enters the sewage treatment system. Pretreatment by physical or chemical processes are usually required for industrial waste disposal.

c. The planner must be aware of the industrial activities of the installation and collect sufficient data from the engineers and specialists on the origin and types of waste that will require such special treatment. The objectives of the industrial wastewater systems include the following:

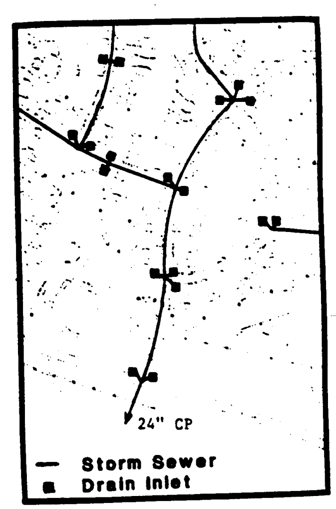
1) Collection - provide means to collect and transport industrial sewage under general requirements to the point of discharge into a treatment facility.

2) Treatment - provide treatment facilities which will improve the quality of the wastewater to the level required by regulatory officials.

3) Transportation - provide means to transport treated water to regional system outlet point or final treatment facility.

2-10. Wastewater System - Storm Drainage

a. Storm water management, or "storm drainage" is the process of collecting runoff in such a way as to prevent damage to property and inconvenience to normal daily activities. An open drainage system is one where storm runoff is conveyed by overland flow, gutters, channels, swales, to a point of discharge or constraint. A dosed system consists of a network of inlets, manholes, pipes and connectors beneath the drainage area. Additionally, oil separators may be part of the system where industrial wastewater o=~ A major responsibility for the Engineer in performing the storm drainage inventory is a determination of the magnitude of a flood with respect to the probability of the flood level being exceeded for any period of time. The overall issues that must be addressed in the storm drainage inventory are:



- How often does flooding occur?
- Where are the 100-year floodplains?
- Where are the obstacles that create flood conditions?
- Are existing inlets, pipes, and channels adequate or acceptable?
- Where does the water go and does it flood?
- How pervious is the soil?

b. A military installation is as vulnerable to the effects of flooding as any other urbanized community. Land use development changes the land's natural response to rainfall. The most common effects are reduced infiltration and increased travel time, which results in significantly higher rates of runoff. The volume of runoff from a storm event is measured by the amount of precipitation and by infiltration characteristics of the soil, type of vegetation cover, amount of impervious surfaces such as roadways, parking lots, roof tops, sideways, tarmac. Travel time of the flow is determined by measuring the slope, length of flow, depth of pipe and roughness of flow surfaces.

c. The planner must recognize that development of land and transportation systems will have an impact on drainage. As land is transformed from pervious to impervious surfaces, and as slopes are altered, the runoff of stormwater will increase. Therefore before development begins or is planned, it is important to analyze the existing patterns of runoff (e.g., in the Natural Resources Plan) in order to establish a datum for future land development (Figure 2-7).

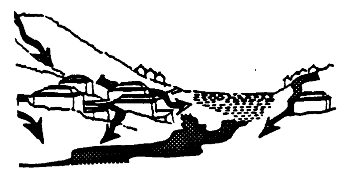
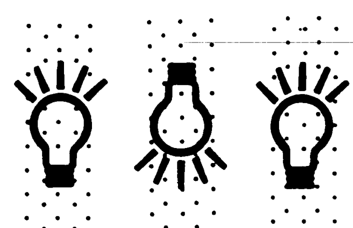


Figure 2-7

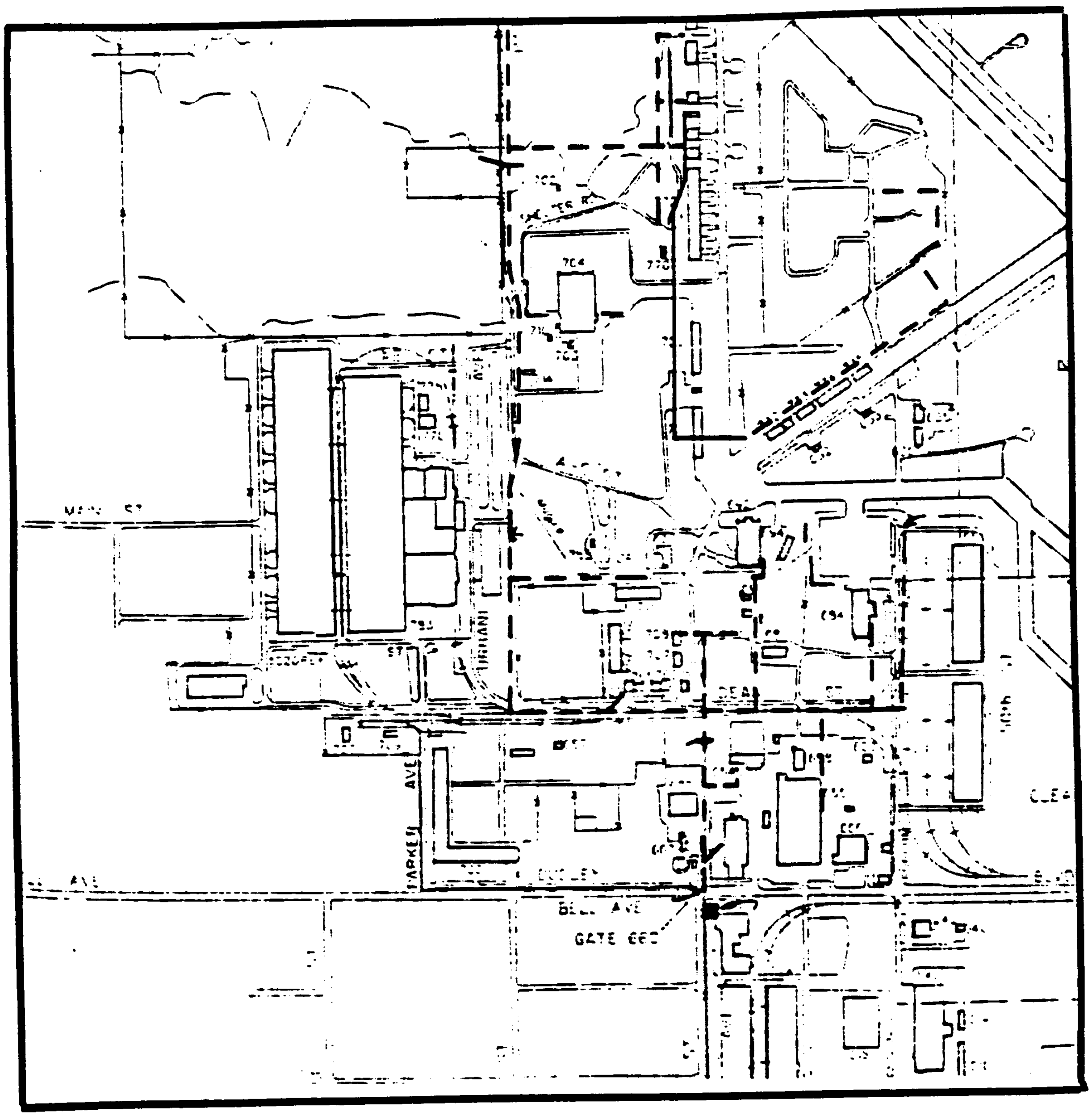
2-11. Electrical Distribution System

a. The electrical distribution system provides for the domestic, industrial and commercial-type load requirements. The system typically consists of the following (Figure 2-8):



- Incoming high voltage that emanates from a commercial utility source usually located outside the installation and which terminates in a main electrical substation.
- A distribution system consisting primarily of power lines (aerial and/or underground feeders), substations, and switch stations which distribute power throughout the installation to individual facilities. The high and/or medium voltage used on the distribution system is converted to a lower utilization voltage by transformers at each facility or group of facilities.

Electrical Distribution Map
Ft. Alpha/Hometown AFB
Figure 2-8



LEGEND:

- ■ Switchgear
- —— Underground Lines
- - - - Overhead Lines

- On-site power generation is typically used for emergency conditions such as commercial power outages. It consists of individual generators located at each critical facility and/or multiple generator power plants which may supply a number of facilities or the entire installation.

b. Factors related to the availability, capacity, maintainability and reliability of existing and proposed electric power supply and distribution systems should be determined during the inventory process. Specifically, the engineer should have an understanding of:

- the various components of the electrical power system
- characteristics and capacities
- the types of facilities and major equipment on the installation
- the total installation demand
- voltage levels that operate this equipment
- the time and manner in which the equipment operates (to determine the power load during a day or season)

The existing distribution equipment must be inventoried to determine its future potential or whether it is limited in servicing future development areas and/or meeting anticipated peak loads. This information provides the required baseline from which the existing system and future needs can be evaluated.

c. It is also important to determine the specialized requirements of facilities that are critical to the installation mission so the electrical system can be planned with the necessary reliability and continuity of service in mind. The existing equipment should be inventoried to establish which loads will be required. Additional commercial and on-site distribution feeders, expansion of on-site generation and sub-station facilities, and other system improvements (e.g. Power Conditioning, Continuation Interfacing Equipment (PCCIE)) may be required to accommodate present or future requirements. Once the inventory is performed and recommendations are made, the engineer will be able to alert the municipal provider of the proper level of uninterruptible power that is required.

d. Another important consideration of the electrical distribution system is a periodic maintenance program which will allow for the equipment to be on-line at all times, notwithstanding part failures which cannot be prevented by inspection. The various equipment manufacturers provide recommended service intervals and what actions (inspection, testing, changing, adjustments) are required at that time.

e. A street lighting system consists of lamps, poles, panels, control equipment and an underground duct or overhead wiring system. It must be designed to provide adequate levels of lighting - based on the needs of the installation. The existing system should be inventoried to determine whether changes to the lighting levels and of the type of high intensity discharge (HID) light fixture (quartz, mercury, eodium) are desirable. It should then be determined by the Engineer whether any of the existing equipment has any useful life remaining. This includes the poles, wiring panels and control equipment.

2-12. Central Heating and Cooling

a. In almost any climate, heating and/or cooling must be provided for in most buildings on the installation. These services are typically provided either by separate furnaces and air conditioners in each building (HVAC) or by a system that uses heating and cooling media derived from a central plant. In the first case, air conditioned buildings would be equipped with a heating system requiring fuel and an air conditioning system requiring refrigeration equipment. HVAC systems are internal building systems and, therefore, are not considered as part of the utilities systems planning for the installation.) In the second ease, the fuel and the refrigeration system are enclosed in a separate plant and from that plant, heating and cooling media (steam, hot water, chilled water) are delivered to the individual buildings. It is also possible for a central plant to produce electrical power as well as cooling and heating media through a process called cogeneration.

b. Early in the utilities systems planning process, decisions must be made with respect to the selection of the heating media, cooling media, equipment types and distribution system. These decisions generally fall within the purview of engineering personnel and experts. Therefore, elements of the central heating and cooling systems inventory include documentation (Figure 2-9) by the engineer of the:

- Availability of steam , heating hot water and chilled water.
- Capacity of existing central boiler and chiller plant.
- Availability of fuels.
- Availability of electrical power.
- Type(s) capacities, location and condition of piping distribution systems for heating and cooling media.
- Site conditions that will affect new piping distribution systems on the installation.

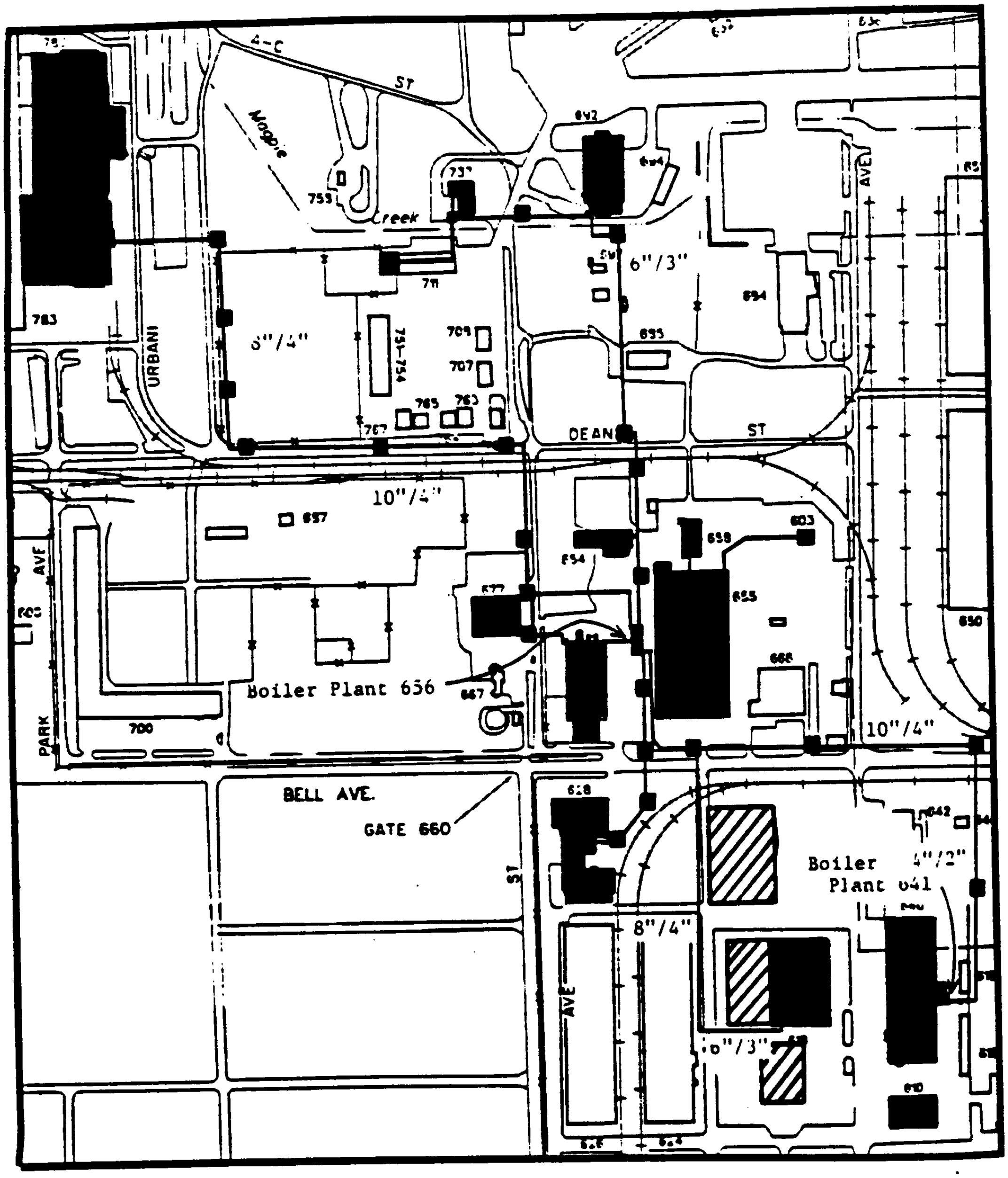
2-13. Natural Gas System

a. Where a reliable supply of natural gas is available, it is usually the fuel of choice. It is generally no more expensive than other fuels and it is more easily transported and convenient to use (except for electric power). In most cases, it is more desirable than electric power from the standpoint of energy conservation and cost.

b. If natural gas is used on the installation or if it is the fuel of choice, several items of information must be obtained by the Engineer from the Municipal Gas Company and other technical experts (Figure 2-10). They include:

- Identification of gas company
- Location and size of street mains
- Type of service (firm or interruptible)
- Service pressure
- Location of service
- Available capacity
- Gas pressure

Heating and Cooling System
Ft. Alpha/Hometown AFB
Figure 2-9



LEGEND:

Existing Manholes & Lines

Existing Buildings on System

Buildings to be added to System

- Gas heating value
- Gas specific gravity
- Type of gas available (Natural, LPG, Mixed)
- Pipe size at point of connection
- Site conditions that will affect the installation of new gas piping.

c. Existing and any proposed routing for the new gas piping must be carefully evaluated. This piping must be protected against mechanical damage, corrosion, and freezing. Running of gas piping under buildings should be avoided whenever possible. Where it is unavoidable, the pipe must be run in a conduit.

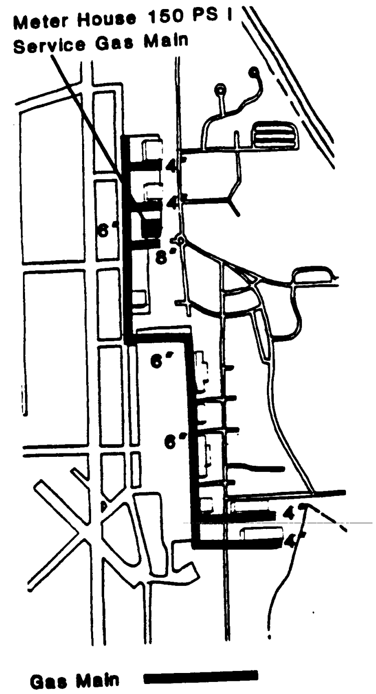


Figure 2-10

2-14. Liquid Fuels System

a. The purpose of a liquid fuels system is to provide various fuels, such as (gasoline and diesel) fuels, liquid nitrogen, JP-4 aircraft fuel and deicing fuels for aircraft, in support of the installation's military mission. A typical system consists of underground pipe lines, railroad spurs and fuel truck access roads providing fuel from off-installation sources to storage tanks located in pre-designated storage fields. At selected installations a system of distribution to fueling hydrants or pipes is desirable for rapid fueling of strategic aircraft.

b. Several factors must be considered when evaluating or planning for a liquid fuels system. They include:

- Existing storage capacity.
- Adequacy of pipelines and pumps.
- Site of proposed system with respect to clear zone, existing facilities, and landscape.
- Future expansion capabilities.
- Number of parking spaces using a hydrant.
- Aircraft parking plan.

2-15. Centralized Aircraft Support System (CASS)

a. Centralized Aircraft Support System (CASS) is a strategic aircraft maintenance system used by the Air Force/Army to provide ground support for parked aircraft. Its objective is to service aircraft via self-contained underground utility pits customized for the specific needs of the installation. Utilities contained in the CASS include:

- Electrical Power
- Compressed Air for Engine Starting
- Coolant Laps
- Air Conditioning
- Hydraulic Systems
- Other Systems as Required

CASS includes:

- ***Electrical power***
- ***Compressed air***
- ***Coolant supply***
- ***AC***
- ***Hydraulic systems***

b. The advantages of CASS over conventional aerospace ground equipment (AGE) are:

- Manpower, energy and repair costs are decreased
- Turn-around time is improved due to:
    - Convenient access to equipment
    - Ramp time shortened
- Safety is improved due to:
    - Less exposed equipment
    - Less noise
    - Less congestion on flightline
- Reduced risk of high pressure.
- Reduced risk of electrical conduit failure due to buried system.

3

Forecasting & Analysis

CHAPTER 3

FORECASTING AND ANALYSIS

A. OPPORTUNITIES AND CONSTRAINTS

3-1. Characteristics

a. Each installation will have characteristics that constrain development or present unique opportunities. The planners and engineers must identify and understand the extent of these constraints and opportunities in developing the Utilities Systems Plan (Figure 3-1). Most of the features of the utilities system will have been identified by the planner and the engineer and will be mapped (Tabs or existing conditions maps). In fact, a composite map showing all utilities systems features is required or recommended. These Tabs/Maps provide the technical basis and input for the various utilities systems opportunities and constraints themselves. For example, the sizes of the storm apertures along the drainage or creek channels may not be meeting current demand; or the size of the present sewage treatment facility may limit the capacity of the entire system.

b. In order to prepare a complete evaluation of utilities systems constraints, it will be important to document and consider other planning and environmental features, both existing and proposed, on the installation. For example, environmental factors such as steep slopes, floodplains, hazardous waste Sites, unique climatic conditions, may limit the ability to lay underground lines or site an electrical substation. Conversely, an installation with a sufficient volume of good quality ground water could serve the entire mission thereby reducing dependence on municipal resources. A reservoir would also be an effective means of storing non-potable water while creating an aesthetic and/or recreation feature.

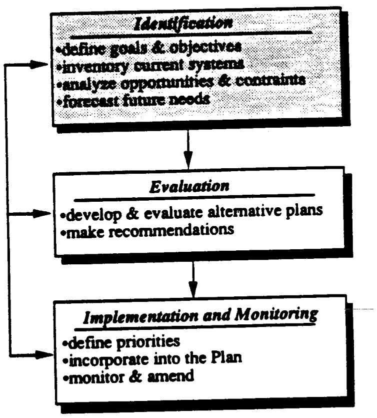

Identification
•define goals & objectives
•inventory current systems
•analyze opportunities & contraints
•forecast future needs
Evaluation
•develop & evaluate alternative plans
•make recommendations
Implementation and Monitoring
•define priorities
•incorporate into the Plan
•monitor & amend

Figure 3-1

c. A useful exercise for the planner in this identification process would be to prepare a series of maps that overlay a variety of utilities systems planning influences (e.g., transportation networks, land use plan, natural features, utilities systems, etc.) (see Figure 3-2). This type of graphic planning tool will help to put the technical utilities systems needs/requirements in the larger planning context as well as initiate a process of forecasting changes and generating alternatives that will be most responsive.

B. FORECASTING CHANGES

3-2. Forecasting

Community planner sets forth requirements.

Land use and long range facility development plans are basis for determining future demand.

Engineer forecasts system responses.

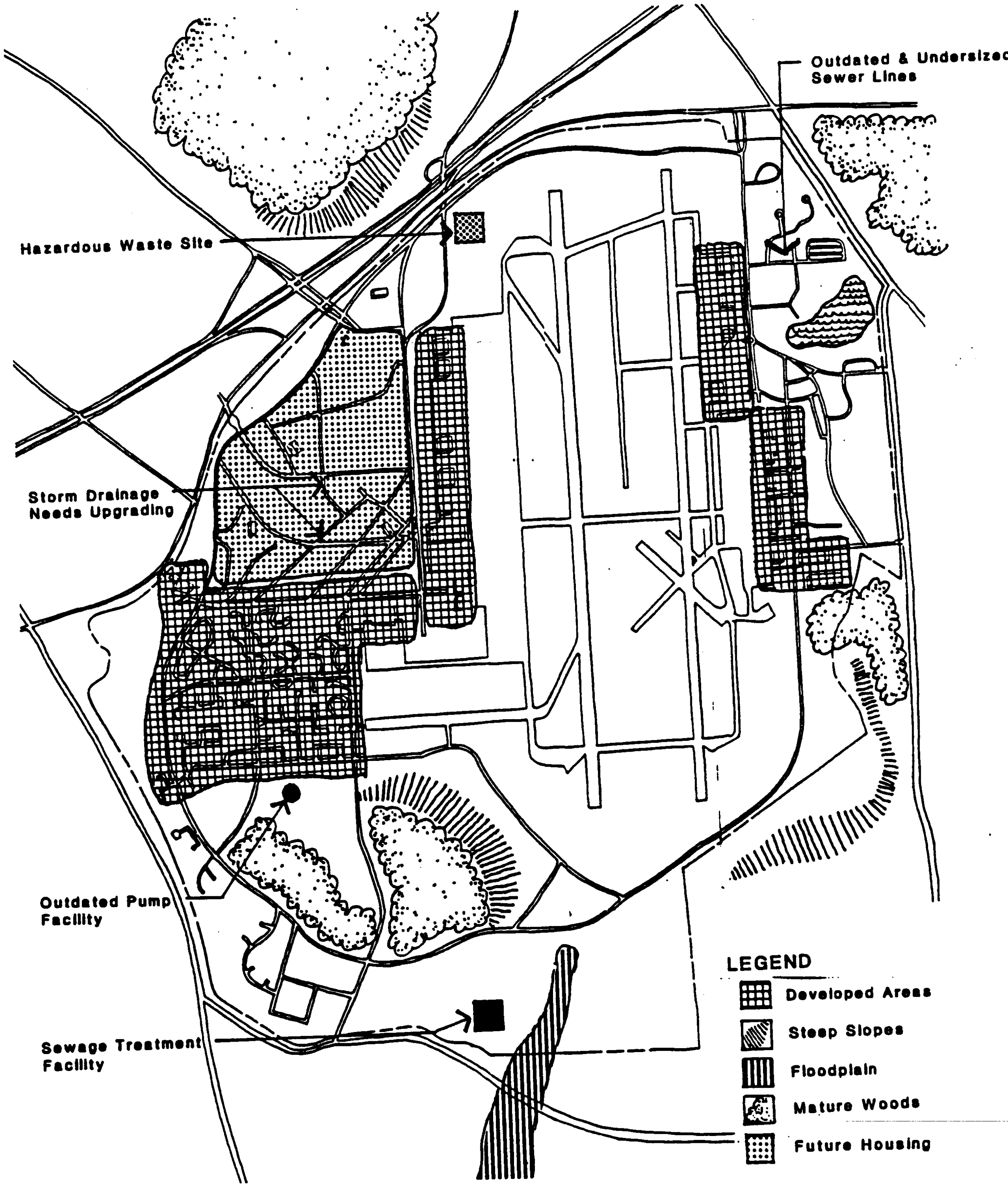
a. Forecasting is a critical element of the utilities planning process. The planner and the engineer must work closely in this effort. In most cases, the planner needs to set forth the land development and mission-related requirements for technical interpretation into systems responses by the Engineer. The planner derives this information from the land use, transportation and short- and long-range facilities development planning efforts.

b. Forecasting for utilities requirements necessitates the consideration of the proposed land use and transportation planning activities on the installation. The operational characteristics of what is existing and working, or what is NOT working, are the backbone for forecasting future demands as they develop.

- Are the utilities systems currently in place adequately serving the mission?
- Are current utilities capable of accommodating additional development?
- What new construction is planned and are the existing services adequate to support the construction?

Combined Constraints Map

Figure 3-2



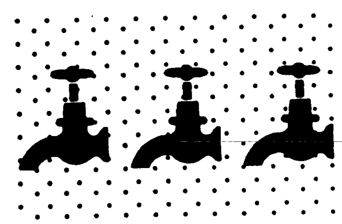
- Are new roads being planned that can be combined with the proposed utility network?

c. Utilities systems forecasting works with two aspects of the system: supply and demand. These are common terms used to describe the quantity and quality of services offered (supply) and the ability of the consumer to obtain the service (demand).

d. A picture of current conditions (existing supply and demand) will be available as a result of the basic inventory. Future needs can then be determined through developing forecasts based on the projected demand. Forecasting considerations vary by type of utility systems and have direct implications for the development of alternatives.

3-3. Water System

a. Water Consumption. The Land Use Plan and Long Range Facilities Development Plan generally are the basis for determining future water consumption demand. Through use of these plans, projections can be made regarding the requirements of new construction throughout the installation. With the projected demand figures, the adequacy or inadequacy of existing facilities will become apparent. The "bottom line" in comparison will be the project's maximum day demand versus the current maximum deliverable under normal conditions.



Land Use Plan provides basis for determining future water demand

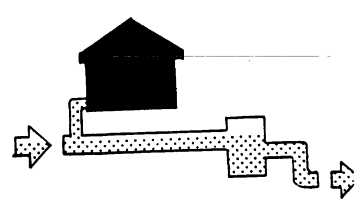
b. Life Expectancy. Another consideration in future demand is that of life expectancy. The economic periods of design of a water storage or distribution structure are related to its length of life, initial cost and cost of increasing capacity. Design periods depend on the type of water source. For example, wells that are easy to drill are considered to have a reliable life of approximately 5 years. Reservoirs have a design period of 30 to 50 years. Pipeline life depends on the type of pipe used, the corrosiveness of the soil and the quality of the water being fed. Cast iron has a life of 100 years plus, while steel has a life of only 25 years. If a component of the water system is approaching the end of its design life, it may be worthwhile to replace the entire element rather than add-on in order to satisfy new demands. Regulations state that well capacity shall be adequate to supply maximum day demand in 16 hours. (See AFM 88-10 and TM 5-183-5 for design details.)

c. Water Distribution System. Using the I-and Use and Transportation Plans as indicators, the distribution system should be a network of primary and secondary feeders with service lines connected to every facility on the installation. Water tanks should be centrally located to facilitate distribution while remaining compatible with adjacent land uses. Booster pumps and piping must be able to provide the required pressure demands. Specifically with regard to fire protection requirements, spacing of fire hydrants must be in accordance with AFM 88-10, TM 5-813-6. Other factors considered are:

- Operation and maintenance requirements, including power demand;
- Chemical requirem ents
- Life-cycle costs.

3-4. Wastewater System

a. Sanitary Sewer. As new buildings are constructed and put into use, the flow of wastewater will increase. The Long Range Facility Plan will indicate those buildings that are scheduled for demolition or replacement. Projections of future flows can be estimated based upon design criteria and from data concerning proposed building size and use. A systems layout should be drawn on a contour map, along streets, using arrows to indicate the direction of flow. Ridges on the installations may necessitate two or more layouts with separate lines to the treatment plant (Figure 3-3).



b. Industrial Wastewater

1) Industrial activities whose waste treatments are alike should be clustered together where possible in order to maximize efficiency in industrial treatment.

2) The type of treatment depends on the nature of the waste. Often equalizing tanks are installed prior to normal treatment. This will help neutralize concentrations of acid and alkaline solutions Also, fine screening is used to remove suspended matter and skimming is done to remove grease and oil.

3) Each installation has a different industrial sewer system. Each new project will have to be evaluated to determine the feasibility of using pretreatment on location or within the industrial waste collection system, if available.

4) Typical constraints on the industrial sewer system include:

- insufficient size of treatment facility to handle peak flows (capacity problem constraint)

- excessive distance that the treated effluent must travel to the regional connection (increased maintenance, additional lift stations/lines required)

- inadequate metering throughout the system (accurate usage inventory and infiltration detection is made difficult).

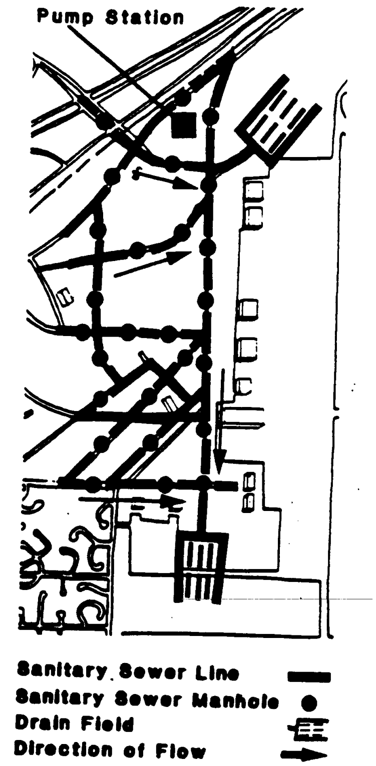


Figure 3-3

c. Disposal System. Most sanitary sewerage disposal is achieved by the means of gravity. Pump stations are needed when gravity flow is inadequate for the complete disposal of wastewater. Conditions that necessitate the pumping of sewage, are where:

- Topography is adverse to gravity flow.

- The pipe has to be buried so low that the cost is too high.

- Ridges must be crossed.
- The sewer outlet is below the receiving water level.
- The level of flow must be raised to the treatment plant.

d. Coordination/discussion with the local community is especially critical with respect to treatment capacity for the projected flows. Most community treatment plants have capacity limits that are expressed in terms 6f gallons per day (gpd) that can be treated. Many communities are near or exceeding their capacity limits.

3-5. Storm Drainage

a. As discussed in Section 2-10b, when population and building density increase, the effects of uncontrolled runoff and other drainage becomes problematic to the installation, adjacent community and its citizens. The amount of runoff from a storm event largely depends on detention, infiltration into the ground and evapotranspiration, which is related to soil types, type of vegetation and the amount of impervious cover (Figure 3A). Estimating the magnitude and frequency of future flood events makes systematic planning and installation of structural and nonstructural measures to reduce hazards to acceptable levels possible.

b. Determination of the design capacity of drainage system components requires some subjective judgment (see Tables 3-1 and 3-2). The judgment involved in this determination may be minimized by using the following procedures:

1) Consider the risk of loss of life or consequences of interruption of the primary mission operations, select a level of confidence and time period for which flooding to a specified depth is undesirable.

Water Cycle Components

Figure 3-4

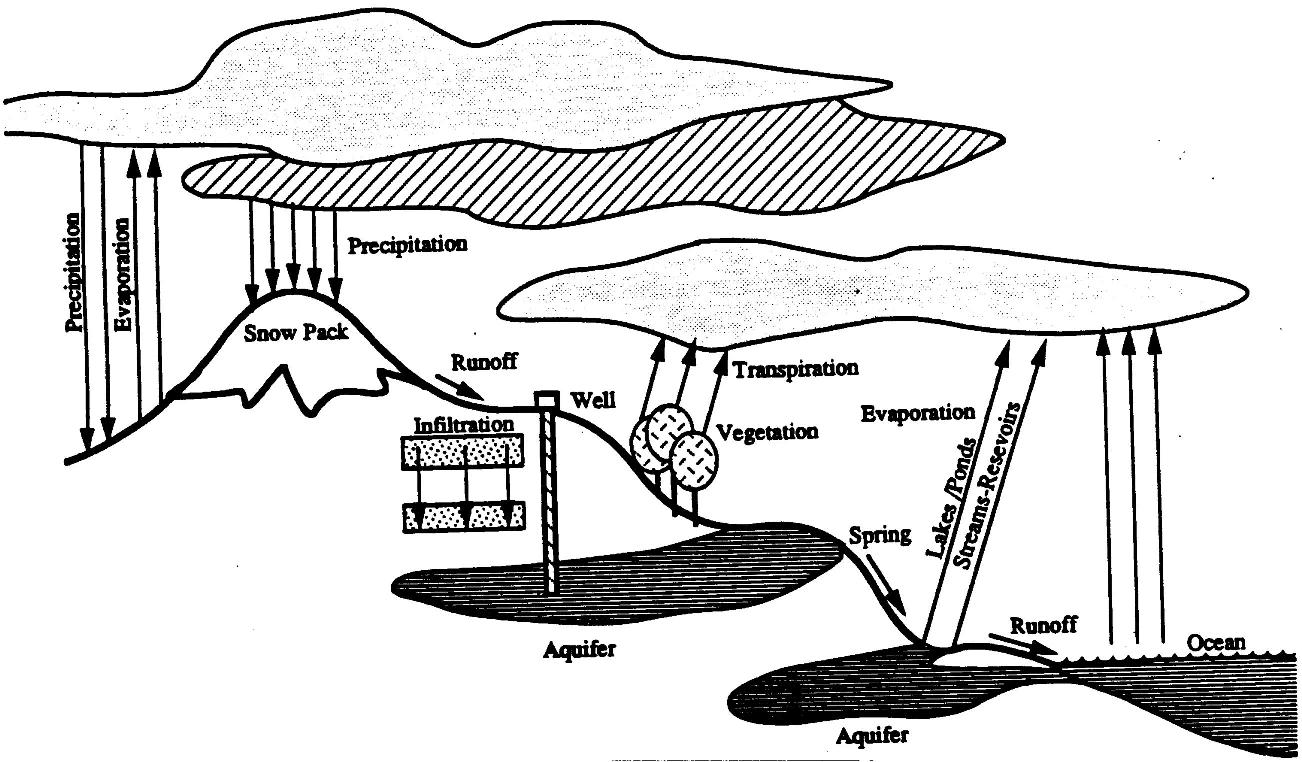


Table 3-1
MEASURES FOR REDUCING AND DELAYING STORM RUNOFF

Surface Use	**Reducing Runoff**	**Delaying Runoff**
Parking lots and other impervious surfaces (buildings)	1. Porous pavement a. Gravel parking lots/driveways b. Porous or punctured asphalt 2. Concrete vaults and cisterns beneath parking lots in high value areas 3. Vegetated ponding areas around parking lots 4. Gravel trenches 5. Cisterns for individual buildings 6. Gravel driveways (porous) 7. Contoured landscape 8. Ground-water recharge a. Perforated pipe b. Gravel (sand) c. Trench d. Porous pipe e. Drywells 9. Vegetated depressions	1. Grassy strips on parking lots 2. Grassed waterways draining parking lot 3. Ponding and detention measures for impervious areas a. Rippled pavement b. Depressions c. Basins 4. Planting a high delaying grass (high roughness) 5. Grassy gutters or channels 6. Increased length of travel of runoff by means of gutters, diversions, etc.

Table 3-2
ADVANTAGES AND DISADVANTAGES OF MEASURES FOR REDUCING AND DELAYING RUNOFF

Measure	Advantages	Disadvantages
A. Cisterns and covered ponds	1. Water may be used for: a. Fire protection b. Watering lawns c. Industrial processes d. Cooling purposes 2. Reduces runoff while only occupying small area 3. Land or space above cistern maybe used for other purposes	1. Expensive to install 2. Cost required may be restrictive if the cistern must accept water from large drainage areas 3. Requires maintenance 4. Restricted access
B. Surface pond storage	1. Controls large drainage areas with low release 2. Esthetically pleasing 3. Possible recreation benefits a. Boating b. Ice skating c. Fishing 4. Aquatic life habitat 5 Increases land value of adjoining property adjoining property	1. Requires large area 2. Possible pollution from storm water and siltation 3. Possible mosquito breeding areas 4. May have adverse algae blooms as a result of eutrophication 5. Possible hazard due to accidental drowning 6. Maintenance required

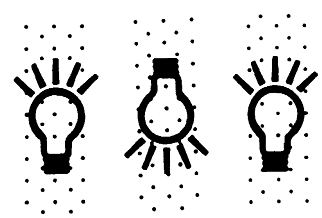
2) Analyze the effects on the emergency response teams and site security should flood waters be allowed to reach a level which might close off access, short out a transformer, or disenable critical life safety and security functions.

3) Perform an economic analysis to minimize the total expected flood-related cost over the projected life of the facility. This cost includes the expected cost of damages plus the cost of flood protection provisions and the drainage system. Select the worst-case flood from steps a and b to be the design level of flood protection.

4) Perform an analysis of the hydrologic conditions. This includes an examination of the hydrology of the region and a capacity analysis to determine the ability of the existing system to handle future water flows. There are three general areas of concern: hydrology, capacity of the system, and the ability to manage flooding.

3-6. Electrical System

a. In order to prepare accurate forecasting for the electrical needs of the installation, extensive coordination with the public utility companies in the community is required. Existing system capacities and loads must be evaluated in the inventory phase in order to determine deficiencies and opportunities. The demand/needs generated by the addition of new facilities, the changes to existing mission requirements or the inadequacies of the existing situation are able to be analyzed as part of the forecasting effort.



b. If the requirements of the installation and its future expansion needs are not properly identified, the following will likely occur:

- Delayed delivery of power.
- Insufficient power to operate the-installation.

- Underdesigned equipment and/or substation feeders to handle the various facility loads.

- Insufficient equipment capacity to allow for normal changes and expansion in the existing facilities.

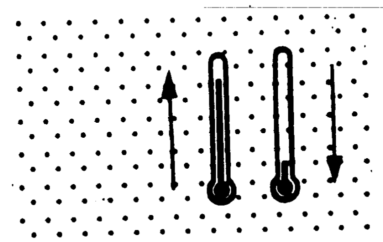
- Unsafe operating environment for personnel.

- Inadequate quantity of spare parts.

- Inadequate quality of power for sensitive electronic equipment/system.

3-7. Central Heating and Cooling

a. Forecasting the requirements for central heating and air conditioning consists of an examination of the facilities and uses proposed in the I-and Use Plan and Long and Short-Range Facility Development plans and the application of appropriate demand/use factors for the heating and cooling requirements. These factors are dependent on climate, type of construction and type of occupancy. The Engineer will produce these forecasts from the requirements information set forth by the planner. In many cases, individual HVAC systems are used for new buildings.

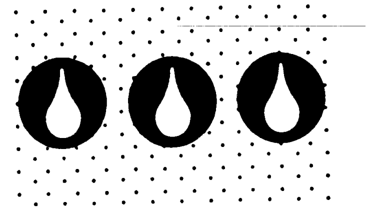


Use of central heating/ cooling depends on:

- ***available plant capacity***
- ***climate***
- ***type of construction***
- ***type of occupancy***

b. The Engineer will also perform an analysis of present and future building cooling and heating loads and determine the integrated load for the installation using appropriate diversity factors A determination of the amount of redundancy (if any) to be built into the system will be made. If central heating and cooling plants are indicated, pressures (steam) and temperatures of cooling and heating media must be selected. The type(s) of chillers, boilers, pumps and appurtenances will then be selected depending on the size and nature of the loads. The type of distribution piping network to be used will also be determined.

3-8. Natural Gas System



a. Forecasting the requirements for a natural gas system requires an estimate of the loads for spare testing, hot water heating, cooking, laundry, central heating and cooling plant and other miscellaneous loads generated by existing and new facilities. This estimate will be made by the engineer.

b. This information will be used to lay out utility corridors and to locate gas meters and pressure regulators.

3-9. Liquid Fuels System

a. The fueling requirements for the Air Force/Army aircraft are determined by the installation's mission, number of aircraft, type of aircraft used, and refueling requirements. This data will dictate required flow rates and tank capacities needed to accomplish the mission.

Liquid fuel requirements are based on:

- ***mission***
- ***number and type of aircraft***
- ***refueling needs***

b. The proposed location of liquid fuels storage is also an important forecasting consideration. The following features should be taken into account:

- Accessible to primary supply sources?
- Internally secure from potential terrorist activities?
- Directly linked to mission demand locations?

Security is an important consideration for locating fuel storage tanks.

Consideration/evaluation of existing and possible future state regulations should be made.

3-10. Centralized Aircraft Support Systems (CASS)

a. Centralized Aircraft Support Systems (CASS) is a specialized system that is used to meet requirements at certain installations, depending on its needs. A CASS System at an installation housing the B-1 bomber differs from a CASS at an

installation that has B-52's or K-10 aircraft. This is due to the different requirements for conditioned air, liquid coolants and hydraulics in the aircraft.

b. In planning and forecasting the needs of a CASS system, the long-term mission of the installation must be recognized and the type of aircraft that will ultimately be operating must be defined.

4

Alternative Plan Development

CHAPTER 4

ALTERNATIVE PLAN DEVELOPMENT

A. ALTERNATIVES

4-1. Selecting Alternatives

a. Early in the planning process it is advisable to identify the most feasible alternatives from a range of alternatives (Figure 4-1). Tile alternatives will typically be oriented to specific systems or may address overall utilities delivery (e.g., whether to use community resources or develop the capability on the installation). Tile expertise of the Engineer is required in the lead in this phase of the process, particularly with respect to the individual system alternatives.

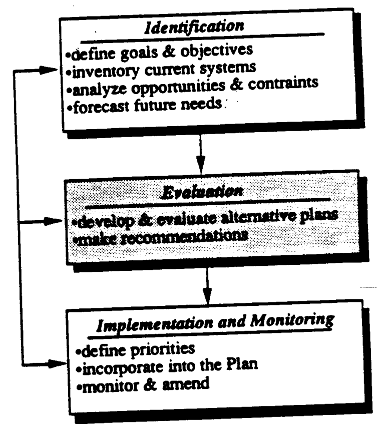


Figure 4-1

b. Tile list of alternatives should cover a wide variety of actions. Tile alternatives may range from major construction to minor adjustments. However, most alternatives typically involve changes to existing facilities and services rather than actions requiring major restructuring of the utilities system. In this regard, one of the overall alternatives might be to make changes to the Plan itself (i.e., decrease level of development, alter locations of facilities).

c. Examine the list of alternatives relative to the current and future needs and the existing constraints on the installation. Although the number of potential alternatives on the list may be large, there are likely to be no more than two or three that are responsive to the identified needs and in keeping with the identified constraints. At all times, make sure that the selected alternatives coincide with the goals and objectives.

d. Once the alternatives have been identified, prepare a Project Description consisting of the following items:

- Description of need - characteristics, problem
- Location of need (shown on a map)
- Applicable objectives to be met
- Potential alternatives
- Data requirements

e. Tile advantage of preparing a description is to determine if the alternatives really look feasible or should be dropped from consideration. Keep in mind that the alternatives that pass this review will be included in the detailed evaluation. Depending upon the needs, different alternatives may be necessary for short-term or long-term plans.

Short-term/lower cost alternatives must be consistent with long-term development objectives.

f. Alternatives can be categorized according to time and cost requirements, degree of service to be provided and potential for future expansion. Generally, short-term actions to meet existing deficiencies and current needs would be lower cost, while major changes requiring more time to implement would tend to cost more. Since most installations already employ established utilities systems, the need for planning changes several years into the future often does not seem as necessary. Short-term and/or lower-cost alternatives will fit many of the needs, but they must be consistent with the longer-term development objectives. Therefore, the emphasis will most often be placed on improving the use of existing facilities as opposed to building totally new systems.

g. Most installations are located adjacent to or near communities that provide support services to the installations It is likely that these communities are self-sustaining in terms of providing their own utility services (i.e., water, electricity, sewer).

Where deliverable municipal supplies are adequate and distances from the source are reasonable, the installation would typically use the community resources. The installation should not compete with the community with respect to utilities provision, but rather should draw on their resources.

h. The remainder of this chapter includes brief discussions of typical systems alternatives applicable to an installation.

B. SYSTEMS ALTERNATIVES

4-2. Water System Alternatives

a. The alternatives relating to the design and operation of water systems discussed below focus on alternatives that affect demand and circulation. Specific design criteria are provided in the pertinent Air Force and Army regulations.

b. Water sewer systems must be planned to meet the needs of the population. These needs can vary significantly based on the function and location of land uses and buildings. Alternatives are generated as result of:

- Change in demand of water
- Change in distribution
- Change in water supply
- Change in operation

c. Demand Change. Demand rates of water are directly related to population densities at specified periods in time. Alternatives to demand can be achieved in several ways. Modification of the I-and Use Plan can redistribute the population and buildings to relieve high-density usage in one given area. Also, reduction to peak-hour demand by use of staggered shifts may be an alternative (although extreme) to meet the demands.

CHANGE IN DEMAND:

- ***modify plan***
- ***stagger shifts***

d. Change in Distribution. This action includes improvements to the pipe network and pumping system.

CHANGE IN DISTRIBUTION:

- *increase pipe diameters*
- *type of pipe*
- *additional pipe and manhole system*

1) Pipe Network

- Increasing pipe diameters
- Changes in type of pipe
- Providing additional systems or subsystems of pipes and manholes

2) Pumping System. It is essential that reliability and uninterrupted operation features be considered in determining the type of pumping system to be installed. Other factors are operating cost and maintenance cost, as well as the type and capacity of the pumps.

CHANGE IN SUPPLY:

- *new wells*
- *well improvements*
- *new surface source*
- *municipal suppliers*
- *increase outputs*

e. Change in Supply. Change in supply relates to water usage and generates alternatives when the installation demand exceeds the maximum rate of supply. Also, supply alternatives are a factor when secondary sources are included in the criteria. Such alternatives include:

- New wells
- Improvements to existing wells or surface sources
- Creation of a new surface source
- Other municipal suppliers
- Increase in output of existing sources
- Increase in output of existing wells by replacing pumps or increasing their depth

OPERATION CHANGE:

- *pump improvements*

f. Operation Change. The typical application of this action is to provide pumpage for water that will efficiently provide for the demand pressure. An alternative would be to replace old or inefficient pumps with newer modules or supplement existing pumps and stations with additional equipment.

g. Storage Tanks and Reservoirs. Alternatives with respect to storage tanks and reservoirs can be considered for water service. General improvement to existing storage sometimes is all that is required to achieve the required results. Another action is to raise elevated tanks to higher levels to increase pressure demands. The other alternative is to provide new or additional water storage facilities. As these alternatives are generated and particularly if new facilities are to be developed and require siting, the planner would work closely with the engineer taking into account security and compatibility.

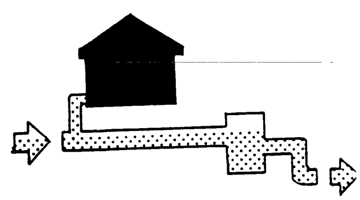
IMPROVE STORAGE:

- ***raise tanks to increase pressure***
- ***provide new/storage facilities***

4-3. Wastewater System Alternatives

a. As was the case with water system alternatives, alternatives relating to the design and operation of wastewater systems discussed below focus on those that affect demand and circulation. Specific design criteria are provided in the pertinent Air Force and Army regulations.

b. Sewer systems must be planned to meet the needs of the population. These needs can vary significantly based on the function and location of land uses and buildings. Alternatives are generated as result of:



- Change in demand
- Change in capacity of sanitary sewer
- Change in distribution/disposal
- Change in operation

c. Demand Change. Demand rates of sanitary sewer are directly related to population densities at specified periods in time. Alternatives to demand can be achieved in several ways. Modification of the Land Use Plan can redistribute the population and buildings to relieve high-density usage in one given area. Also, reduction to peak-hour demand by use of staggered shifts may be an alternative (although extreme) to meet the demands.

d. Change in Distribution. This action includes improvements to the pipe network and pumping system.

1) Pipe Network

- Increasing pipe diameters
- Changes in type of pipe
- Providing additional systems or subsystems of pipes and manholes

2) Pumping System. It is essential that reliability and uninterrupted operation features be considered in determining the type of pumping system to be installed. Other factors are operating cost and maintenance cost, as well as the type and capacity of the pumps.

- Centrifugal pumps are preferred over reciprocating and rotary pumps because of the suspended solids in sewage. With pumps, dependability is more important than efficiency. Slow speed pumps are desirable because they have long life expectancy and are quieter.
- In cases where there is a sanitary treatment plant serving the installation, the analysis of existing treatment facilities may indicate a need for improvement, replacement or removal of the treatment plant the planner works with the engineer to develop recommendations for location.

e. Operation Change. The typical application of this action is to provide pumpage for Sanitary sewer that will efficiently provide for the disposal head (sewer). An alternative would be to replace old or inefficient pumps with newer modules or supplement existing pumps and stations with additional equipment.

f. Treatment Plants. Changes to treatment plants involve a wide variety of actions that can modify and improve operations. Given the technical scope involved in such alternatives, the installation civil engineers or a consultant engineer having expertise in water treatment should be consulted prior to their development or analysis.

g. Industrial Sewer. Industrial sewer alternatives depend on the amount and character of the waste, the type of sewage treatment plant available and its ability to take the load. Given the environmentally sensitive nature of industrial wastes, conveyance alternatives must be carefully coordinated with the Environmental Officer and the appropriate environmental compliance procedures and regulations. The issues related to hazardous waste and environmental quality protection planning will be covered in more detail in other bulletins/manuals.

1) Identification of the waste and cooperation between the municipal authority and the installation should be a priority. It may be necessary to treat installation generated-industrial wastes prior to release into the sanitary sewer system.

2) When pretreatment of industrial wastewater becomes an obstacle, an alternative to consider should be coordination with municipal authorities to determine their ability to treat any unique chemicals used at the installation.

3) Sewage treatment methods described earlier are also used in treating industrial wastes. Retention ponds and/or chemical treatment ponds can also be used to hold the wastewater until the contaminants are neutralized.

4-4. Storm Drainage

a. There is always an element of risk associated with the planning of a drainage system. Although it may be desirable to provide a system that can handle the most extreme conditions, the possibility of even greater extremes always exist. Therefore, it must be accepted that there is always the possibility of conditions beyond the capacity of the system. A typical alternatives analysis for storm drainage can be seen in Table 4-1.

b. Runoff can be detained through proper stormwater management procedures that will ease the impact on downstream flooding. Using retention devices such as ponds, infiltration wells and standpipes, the peak discharge can be modified to an acceptable level.

c. In urban areas where there are constraints for implementation of channels and streams and space is at a premium, a closed system is the common approach to drainage.

1) The advantages of a closed system are:

- Minimizes sheet flow along the ground surface
- Controls velocity of water by setting the grade of the pipe
- Controls the hydraulic gradient

2) Disadvantages of the closed system:

- Cost is greater
- Inlet, manholes and pipes can close causing upstream flooding
- Inlet grates can be dangerous to bicycles

3) The advantages of open systems:

- Easy to maintain
- Minimum capital cost
- Encourages open areas and landscaping

Table 4-1
STORM DRAINAGE ALTERNATIVES ANALYSIS

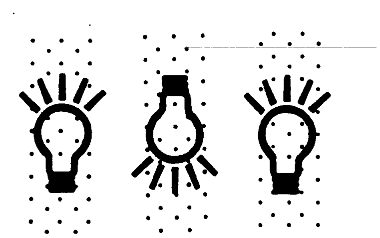
Typical Problem	Probable Cause	Alternative Solution
Drainage System - Caused Flooding	Inadequate pipe sizes	• Replace with larger diameter pipe • Provide secondary backup system • Increase velocity of flow thru system • Provide diversion ponds
	Insufficient number of inlets	• Add inlets • Increase size of inlets
	Blockage in system	• Consistent maintenance
Excessive Run-off	Upstream intensity too great	• Reduce the factors contributing to the intensity • Provide retention system • Correct grading to rechannel flow
	Blockage downstream	• Clear blockage
	Improper stormwater drain locations	• Relocate drains • Provide retention system upstream

4) Disadvantages of an open system:

- Allows sheet flow over surface
- Uncontrolled hydraulic gradient can cause flooding
- Rapid flow can be dangerous to small children/animals

d. When feasible, culverts and channels should be located to maintain the natural drainage by following the original drainage grade. The natural location is usually at the bottom of a ravine or stream bed. Minor channel relocation essentially maintains the natural drainage grade. Care must be taken not to create objectionable effects that may unintentionally interfere with the characteristics of the flow.

4-5. Electrical Distribution



a. There must be extensive coordination between the Electric Company (service providers) and the Engineer regarding the needs of the installation and whether the electric company can full them. If they cannot, the alternative of developing an on-site generation plant must be considered.

b. The planner must also consider back-up power requirements in the event of a major power outage. There must be a PCCIE system to protect sensitive computer equipment and other mission-essential requirements while an on-site generator is started.

c. Normally, the electric company's power system is used. Their transmission line will enter the installation either as an aerial source or underground source. The power terminates at a substation which may be an open facility or comprise a totally enclosed structure on the installation. From the substation, power is then distributed to the installation via an underground duct system or overhead line/pole distribution system.

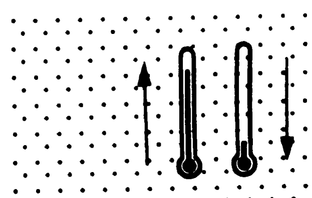
d. The installation substation(s) should be located as close as possible to the existing electric company primary feeders to minimize the required power delivery time. Typically, this location would be on the periphery of the installation. If the substation is (is to be) an open facility, additional security/safety measures and siting consideration, to ensure personnel and equipment protection, will be required.

e. The installation engineers must consider the following in their determination of the size and location of the substation.

- Primary voltage level availability
- Electric demand sources
- New primary feeders
- Complexity of routing new primary feeders through developed population centers or natural restrictions
- Access for both military and electric company service personnel
- Security clear zones

4-5. Central Heating and Cooling

a. Heating and cooling services on an installation are typically provided by either separate furnaces and air conditioners in each building (HVAC) or by a system that uses heating and cooling media derived from a central plant. Whether or not to use central plants to provide heating and/or cooling to an installation is a decision that is based largely on availability and economic considerations. The required economic analysis can be made using techniques described in publications of the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE). The decision must also be made in accordance with reference to appropriate Army/Air Force regulations.



b. Central plants are generally advantageous at large permanent installations with adequate utility corridors that accept piping from the central plant. Advantages inherent to central plants are the following:

- Security for a centralized mechanical plant is easier to provide.

- The aggregate size of centralized equipment is smaller because it is possible to take advantage of diversity in sizing equipment. This is true because in a large installation peak loads for each building do not occur at the same time. Central equipment needs to be sized only for the estimated peak load of the installation and not for the sum of the individual building peaks.

- The type of equipment used in central plants is generally of a higher quality, therefore, equipment life is longer.

- The central plant can be located away from the more populated areas of the installation and, therefore, can be designed to be less annoying with respect to the production of noise, odors, smoke and other pollutants.

- Maintenance is enhanced as the heating and/or cooling equipment is in one place and is more easily accessible.

- Central plants are comprised of a number of units, each of which handles a portion of the plant load. The number of units in service can be controlled to match the load closely, enabling the plant to be run at peak efficiency.

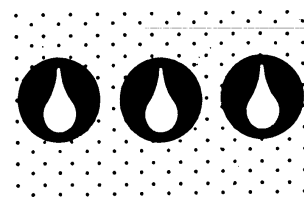
- Space required for mechanical equipment within buildings is reduced.

- Large electrical loads associated with refrigeration equipment are located in one place.

c. The principal disadvantage of central plants is that they require extensive distribution systems and there is a considerable amount of energy loss. If the buildings served are widely separated or are distant from the central plant, the cost of building and maintaining a distribution system would make the system uneconomical. This is why HVAC systems are becoming more common and largely the rule in the case of new construction.

4-6. Natural Gas System

a. The determination of the type of gas to be used at a particular installation is made by the installation engineers in accordance with applicable regulations. Different rate structures are generally available for natural gas service, depending on the reliability of the service.



b. "Firm" gas is the most reliable service and it guarantees that the service will be available at all times. "Interruptible" gas service is, as the term implies, subject to interruption at times of heavy demand or shortage of fuel. Interruptible gas requires a supply of standby fuel for use during periods of interruption of the primary fuel supply but is less costly than firm gas.

1) If there is a need for standby fuel respective of the type of gas service, then there is no reason to contract for firm gas unless interruptible service is not available.

2) At a central plant, oil standby can be provided and the boilers equipped with combination gas and oil burners. It is not practicable to provide standby fuel for dispersed loads such as residences.

c. There must be close coordination between the Engineer and the Gas Company to determine whether or not there is sufficient capacity to accommodate the requirements of the installation. If these requirements cannot be met by the Gas Company, another type of fuel must be considered. If natural gas is available, the point of connection must be determined and pressure regulation and metering must be accomplished in accordance with the rules and practices of the Gas Company.

4-8. Liquid Fuels System

a. Liquid fuels in the form of ground fuels (mogas, diesel fuel), aircraft fuels (JP-4, JP-5 and JP-8 jet fuel) and special purpose fuels (deicing fuel) enter an installation's storage compound via pipeline, tank truck and/or rail car. Either of these modes could be the primary source with the others as a backup method of access to the installation's fuel farms.

b. Above ground storage tanks are preferably located in a functionally segregated area of the installation. Security is an important consideration such that the storage facility must be isolated from possible sabotage. Cathodic protection of the tanks, must be provided whether the tanks are underground or on the surface.

c. Distribution lines may be above ground, placed in accessible trenches or direct buried. Man-rated tunnels (utilidors) are not normally recommended due to cost. All below-grade lines are externally coated and cathodically protected to preclude leaks cable 4-2).

Table 4-2
LIQUID FUELS DISTRIBUTION SYSTEM

Access Type	Advantages	Disadvantages
1. Above Ground	• Ease of access • Lowest installation cost	• Security • Visual quality
2. Accessible Trench	• Ease of access • Available for other services	• Higher cost • Security
3. Direct Burial	• Lower cost to install	• Not directly accessible

4-9. Centralized Aircraft Support System

a. Centralized Aircraft Support System (CASS) are tailored to be compatible with the aircraft serving the installation's mission. The service pits (generally prefabricated fiberglass) can be modified to accommodate the specific line feeds for heating and cooling as required. The CASS can be accessed by:

- access trench
- direct burial

The advantages and disadvantages are outlined in Table 4-3.

b. Available funding could restrict the implementation of CASS. When funding is limited, a two-phase procedure should be considered in installing CASS. There must be careful coordination led by the Engineers when working in the two phase operation to assure the compatibility of Phase I work to Phase II equipment.

- Phase I - Install pits, ducts, pipes and conductors.
- Phase II - Install service components such as coolant equipment, air compressors, power equipment, etc.

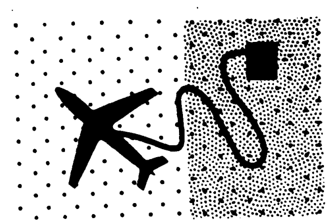


Table 4-3
CENTRALIZED AIRCRAFT SUPPORT SYSTEMS

Access Type	Advantages	Disadvantages
1. Trench	• Maintenance and repair • Flexibility to change or add service	• Cost for excavation • Cost of concrete • Security and safety from lighting, ventilation fire protection
2. Direct Burial	• Least costly • Most secure	• Accessibility

5

Evaluation & Recommendation

CHAPTER 5

EVALUATION AND RECOMMENDATION

A. PURPOSE

5-1. Context

a. The next step in the utilities systems planning process includes evaluation and recommendation (Figure 5-I). The evaluation phase is an examination of each utilities system alternative and how well it provides for changes in land use (as reflected in the 1~d Use Plan) and meets the future mission and installation needs. The recommendation phase identifies and recommends "preferred" alternative(s) as determined through selection criteria.

b. It is important to recognize that there are no absolutes in resolving problems, only compromises that provide the best balance between the essential factors of mission accomplishment, the installation's goals and objectives, and the protection and preservation of mission capability life and property. All must be considered in the context of the complete comprehensive planning efforts on the installation.

c. A systematic approach should be used for evaluation and the process should involve both the planner and the engineer; again where the engineer applies his/her systems knowledge and experience and the planner controls for consistency in land use, policy and mission requirements.

d. Each alternative should be properly considered, adequate predictions of the impact should be made, an accurate means to compare alternatives must be selected, and ensure that the resulting plan is implementable.

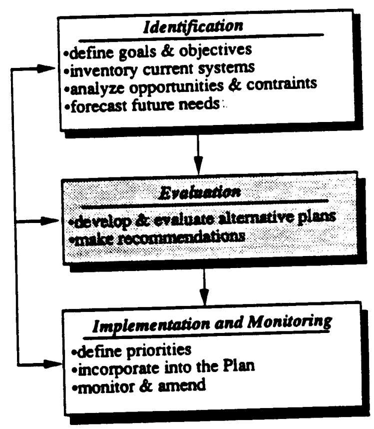


Figure 5-1

5-2. Special Considerations

a. It is necessary to be sensitive to the specific objectives of key persons who will make the ultimate decision to accept or reject the recommended plan.

b. It is also necessary to consider the timing of the plan. As the time period from plan to construction may be several years, it is important to determine whether the plan will have merit now or several years in the future.

c. Aim to choose alternatives that best meet the objectives and fit with the findings/recommendations of the other Plan components. For example, security recommendations for installation layout, facility sitings and construction projects are particularly important considerations in utilities systems alternatives analysis. The various cost constraints that would influence the ability to implement a project should also be kept in mind.

B. EVALUATION OF CRITERIA

5-3. Selecting the Criteria

a. At this point in the process, the planner is aware of the current and future utilities systems problems and opportunities that exist on the installation. The next step is to formulate and apply criteria for measuring the effectiveness of the alternatives. The number of criteria for evaluating different conditions can vary.

b. The decision regarding which "supply" alternative to select, what facilities construction to undertake, and what contract arrangements to enter into will be the result of balancing the costs and benefits. The inputs to this balancing will be the quantitative and qualitative analyses of costs and risks. The decision will depend on the relative importance attached to each of these objectives and the tradeoffs between them. The engineer will conduct the analyses, identify the tradeoffs, and make recommendations regarding the preferred "supply" path. But the planner must be involved in the decision to ensure that the recommended solution is consonant with the mission and program objectives of the installation.

5-4. Meeting the Goals and Objectives. Each concept and alternative developed should meet the goals and objectives set forth in Chapter 2 which should, in turn, be consistent with the Land Use Plan and long Range Facility Development Plan of the installation. If there is a change m the objectives or the mission, reevaluation is necessary. The evaluation of alternatives in meeting the goals and objectives would involve coordinated efforts of the planner and the installation engineers.

5-5. Cost Factors

a. In all eases, cost will be a major factor in the decision-making process. An alternative that exceeds the possible budget or takes too large a portion may have to be dropped from consideration, thus making the evaluation of other alternatives easier. Accurate cost estimates are needed to evaluate alternatives. These can be determined by the engineer or utilities cost experts.

b. The primary purpose of installation utilities systems planning is to meet the utility requirements of the installation's long-term mission and programs. To meet this purpose, the engineer seeks to minimize the cost of the required utility service while, at the same time, minimizing the risk of inadequate supply and/or excessively high costs that could result from unexpected changes in usage requirements or supply conditions. The engineer should include the costs that are readily attributable, using the best estimates available at the time. Where there is uncertainty, a range of values to span the uncertainty should be included.

c. It has been emphasized repeatedly that today's utility decision will have long-term in-pact. Therefore, the engineer strives to minimize the stream of utility service costs over the entire period during which the utility service arrangements will be affected by that decision (payback). Both affected capital and operating costs should be accounted for.

1) Capital costs are usually the easiest to measure, as they are one time expenditures and are based on prior experience. For planning purposes, detailed estimates of each capital cost item are not required. The method used is generally to estimate per linear foot of pipe or per lump sum cost which includes most of the items associated with the system.

2) Operating costs consist of maintenance and operation charges that recur throughout the life of the investment. Maintenance costs include upkeep, replacements, and repair. Operating costs include the day-to-day operating needs of a project. In practice, operation costs can often be lumped together with maintenance costs for estimating purposes. Operating costs can be determined by the engineer or from the public works department in the source community. Also, indirect costs should be considered because the project often creates unforeseen expenditures later on. It is important to include those costs for an alternative that are different from those of other alternatives when evaluating utilities systems costs.

d. A particularly difficult aspect of evaluating the long-term cost streams that may result from alternative facility or supply arrangements is comparing today's and tomorrow’s costs. Since budgets are based on current dollar values, it is advisable to estimate the streams in nominal dollars of the future years (including inflation effects), as well as in constant or real dollars for comparative purposes. Further, because future costs are not incurred presently, the future costs should be discounted so that the cost streams can be described and compared in present value terms. This process is defined as life cycle cost analysis.

Costs include:

- ***Capital costs***
- ***O&M costs***

5-6. Reliability, Maintainability and Survivability

a. If the future adequacy, reliability, and cost of alternative utility supply arrangements were known with certainty, the engineer's decision would be relatively straightforward. The "right" decision would be to select the supplier and to build the necessary utility facilities that would meet the installation's requirements at the lowest possible cost. However, since future requirements and supply conditions are uncertain, the risk of inadequate supply or excessive cost will be associated with each utility supply or facility decision that is made.

b. Reliability, maintainability and survivability are very important to the evaluation of utilities systems alternatives (e.g., on-site power generation vs. off-site sources; overhead power lines vs. underground lines, etc.). As with other criteria discussed below, it is difficult to place an undisputed value on many of these considerations. The decision-making process will be the result of the combined judgment of those experts making the decision. The analytical use of these criteria, along with the consideration of costs will facilitate making it an informed judgment.

5-7. Conformance to Existing Regulations, Technical Orders, Codes, Standards and procedures. Given the increasing technological advances and increased specialization in the various utilities systems designs, there is a need to constantly refer to existing regulations as the standards for guidance in decision- making.

5-8. Environmental Impact The "costs" and "benefits" of the environmental effects of various utilities systems alternatives are often difficult to quantity. Nevertheless, in making future utilities decisions for the installation, environmental impacts as criteria are important and, in many cases are required, considerations. (Refer to

Environmental Quality Protection Plan Bulletin/Manual and Appendix B, Environmental Concerns related to Utilities Systems Construction). An historical example would be the presence of underground cost iron pipe and tanks. Given their identified detrimental effects (cost) on groundwater contamination, the use of east iron pipe would not be considered to be an appropriate alternative. The cost to the environment is too great to warrant the low cost, low maintenance and high rate of survivability of this type of pipe.

C. RECOMMENDATION OF ALTERNATIVE(S)

5-9. Reaching Consensus

a. After completing the evaluation phase, the planner and engineer must come to a consensus regarding recommendations on the preferred utilities systems plan alternative(s). Complex problems may require solutions that involve multiple actions and projects.

Therefore, adequate detail on the specific projects within the plan must be provided to obtain the needed programming and budgeting commitments (during the implementation phase) as well as to build consensus among installation decision-makers.

b. The Utilities Systems Plan recommendations must reflect sensitivity and knowledge of the utilities needs/demands of the community surrounding the installation. For example, a recommendation to expand the capacity of the water system on the installation may also require actions for off-installation supply lines. likewise, the recommendation for a new water supply system on the installation could affect the operations of the adjoining community. In each case, cooperation with civilian agencies is necessary to ensure that the recommendations can be incorporated/reflected in the work program for those agencies.

6

Implementation & Monitoring

CHAPTER 6

IMPLEMENTATION AND MONITORING

A. IMPLEMENTATION

6-1. The Final Planning Phase

a. The implementation process includes the prioritiration, timing and methods necessary to accomplish Utilities Systems Plan recommendations. Implementation involves incorporating these recommendations into the Plan and matching the specific recommended projects with available funds to accomplish both the short and long-range objectives of the installation.

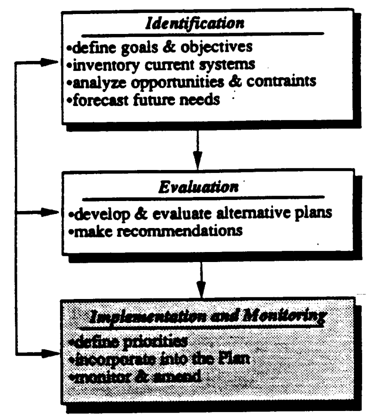


Figure 6-1

b. It is important to note that utilities systems planning for an installation is not an independent task but must be part of the overall comprehensive planning process and feedback loop. As discussed throughout this bulletin/manual, all utilities systems planning must be part of and consistent with planning in the other components of the Plan, particularly the land use and transportation plans. The implementation of other plan components and the utilities systems plan component must be coordinated- Any other installation actions that are necessary to support the development called for in the Utilities Systems Plan component should be included in the design contract as well as in the construction contract.

B. PRIORITIZATION

6-2. Establishing Priorities

a. Prioritization is the process used to determine a ranking of recommended projects in the Long-Range Facilities Development Plan. It also establishes a schedule and costing plan for inclusion of short-range recommendations in the Capital Improvements Program (CIP). Prioritization consists of three elements:

Utility projects directly related to land use plan elements should receive priority

- Installation goals
- Long range development
- Planned projects

The goals and related policies help match project priorities with available funds to produce an effective program of utility improvements.

b. At this point in the process, the programmers on the installation will take the lead role. Their efforts include making the appropriate presentations and submittals to the Facilities Board/Installation Planning Board.

c. The priority ranking factors the relative effects of the specific utilities project recommendations on other projects on the installation. As the land use component of the Plan often drives the implementation of other plan components including utility improvements, the engineer and planner should recommend that those utilities recommendations that have a more direct effect on the implementation of land use plan elements receive priority. Recommendations that could disrupt the timing or feasibility of planned land use development should receive a lower ranking than those that are fully supportive of it.

d. It will be advantageous to have worked closely with the development of other elements of the Plan because the projects are prioritized together. For example, plans for new land use developments on or off the installation may have construction schedules that can be related to a utility project's needs for a power plant or pumping station.

6.3. Funding Prioritization

a. The programmer considers various funding sources for desirable projects. The typical funding arrangements include the Military Construction Program/Authorization (MILCON). Line items for utility improvements can be included with MILCON-funded projects. These projects tend to receive low priorities but should be explored for major actions.

Funding sources:

- ***Separate MILCON project***
- ***Included in facility MILCON project***
- ***O & M Funding***

b. The normal DD 1391 process would be used. Eligible projects can include installation-wide upgrading of the utilities systems or small projects limited to **a** specific upgrade of **a** single utility. Operations and Maintenance (O&M) Funding is available for utility system improvements up to the installation's funding limits. Requests for projects to be funded under the higher Major Command O&M limits are also possible.

c. As funding is usually insufficient to meet all the needs and, in nearly every case, it is physically impossible to undertake all work simultaneously, recommendations must be prioritized. The programmer, with assistance from the planner, prepares a prioritized list of projects, keeping in mind the cost of the project, its timing, and its effect on other installation projects.

d. One of the prime objectives in programming projects is to obtain the greatest benefits from the available funds. Cost often is the leading factor for setting utilities priorities. Generally, direct costs and short-term values are considered in programming priorities.

e. Timing also plays an important part in setting priorities. Short-term recommendations typically receive higher ranking than those that will take longer to implement or that satisfy only future needs. As timing varies among projects, projects should ranked separately within certain time periods, such as immediately, within the next five years, five to ten years, ten to twenty years. This format is compatible with the needs of the five-year CIP. Although specific project scheduling is done only for the five-year CIP, the Utilities Systems Plan recommendations should attempt to relate long-term objectives to those addressed in the short-term.

6-4. Coordination. It is essential to coordinate with civilian agencies responsible for implementing utilities outside the installation. Most communities prepare capital improvement programs for five-year periods. To the extent possible, the installation's approach should be compatible with those of the outside projects. Adequate utilities services are critical to the military mission. Therefore, interaction with the appropriate civilian agencies to coordinate the prioritization of their projects to be compatible with those expected to occur within the installation is necessary.

C. MONITORING

6-5. Using the Utilities Systems Plan

a. The utilities planning process also includes the means to monitor conditions after implementation. Monitoring is an ongoing activity to ensure that the improvements are installed in accordance with the utilities systems plan, perform as expected and are adjusted as necessary. As the utilities systems Tabs/maps are largely computerized, updating and revising them is facilitated.

b. Actual progress on specific utilities projects should be compared with the scheduled progress as shown in the installation CIP. When monitoring indicates serious slippages in a project's implementation schedule, the program should be modified as necessary.

6-6. Plan Updates

a. The utilities systems planning process must be accompanied by a corresponding effort to keep it relevant. As new facilities are constructed and improvements occur, the Utilities Systems Plan will have to be modified to reflect these changes.

Plan update required because of:

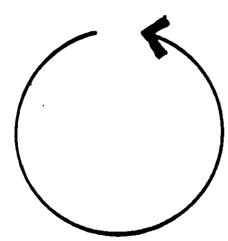
- ***Facility improvements***
- ***Mission changes***
- ***Advances in technology***

b. Changes in mission can have a significant impact in terms of the installation's facilities and supporting systems. Expansion of an installation's mission and the corresponding assignment of substantial numbers of new military personnel to an installation will place significant new demands on or changes to facilities and the utilities that serve them.

c. Advances m technology, the evolution of the surrounding region, and the accumulation of new information can all have impacts that must be accounted for in the Utilities Systems Plan. For example, advances in building construction techniques and energy management may make it possible to consolidate activities within a new structure, thereby reducing a utility system's capacity requirement to that part of the installation.

d. It is extremely important that the utilities systems planning process include a feedback loop so that new information can be continually incorporated. The acquisition of fresh data may require planners to reformulate some of the original goals and objectives in order to more accurately encompass the needs of the changing installation community. Adopting a particular policy or program called for by the Utilities Systems Plan may lead to the discovery of unanticipated adverse impacts that have to be corrected, (either within the Utilities Systems Plan itself or within another Plan component) or it may turn out that a particular recommendation has created an unanticipated opportunity for improving the installation's quality of life.

Feedback Loop



Appendix

APPENDIX A

MODEL STATEMENT OF WORK FOR A CONTRACTED UTILITIES SYSTEMS PLAN

The Utilities Systems Plan component of The Plan should contain a complete description and evaluation of the current and future conditions of each utility system on the installation. The Utilities Systems Plan will vary according to the needs and conditions at each installation, but it should contain, at a minimum, consideration of: the water system, wastewater system (sanitary, industrial and stormwater), electrical system, central heating and cooling, natural gas, liquid fuel, and central aircraft support system.

The work to be performed in conjunction with the Utilities Systems Plan component includes the following items:

1. Introduction, methodology and summary of findings;
2. Statement of utilities systems goals and objectives;
3. Review and evaluation of existing conditions;
4. Identification of problems, constraints, and opportunities;
5. Development and review of plan alternatives;
6. An evaluation of alternatives;
7. Recommended plan; and
8. A plan implementation strategy.

These sections of the Utilities Systems Plan should take the reader through an orderly, sequential process of understanding the context for the plan, the approaches used, what was found to exist, alternative plan elements, and the final plan and its implementation.

1. Introduction, Methodology and Summary of Findings

The introduction should describe the purpose of the Utilities Systems Plan, the installation location and relation to the surrounding region, points of contact on installation, a summary of the installation needs, and highlights of the recommended plan. A person reading only the introduction should be able to understand the primary elements of the plan.

2. Goals and Objectives

The overall physical utilities systems goals and objectives should be presented. These guide the Utilities Systems Plan's development and ensure the plan is in concert with other components of the Base comprehensive Plan/Installation comprehensive Master Plan.

3. Review and Evaluation of Existing Conditions

Existing utilities systems and their condition, location, and relation to each other should be clearly described. The narrative should cover the important aspects of each utilities systems category as stated above. Tables should be used to summarize important data and existing utilities systems conditions and capacity. The Tabs/existing conditions maps described in Appendix C should be prepared. (Tabs 6-1 through 6-13 for the Air Force)

4. Problems, Constraints, and Opportunities

Describe the current problems, constraints, and opportunities identified during the existing conditions inventory. Include a detailed description of what the problems are and the probable causes. Describe any physical, environmental, legal, and other constraints on planning or development. Also, identify existing facilities or conditions that provide opportunities for improved utilities systems. Include off-installation problems and opportunities to the extent that they will affect planning.

Prepare a composite map showing locations of problems and opportunities along with a short narrative of each that is number-keyed to the map. Where feasible, forecast potential future problems resulting from utilities systems or mission changes. Indicate future problems on the same map using a special color or symbol, or by means of an overlay.

5. Alternatives

Review each current utility system's capability of supporting the installation's planned future growth and development. For each current and future problem/opportunity (particularly in concert with the I-and Use and Transportation Plans), describe the feasible alternatives. Use a tabular format to clearly display alternatives. Prepare sketches of alternatives, particularly changes that are otherwise difficult to visualize. These might include physical alterations such as realignments, demolition, and construction alternatives.

6. Evaluation of Alternatives

Evaluate the alternatives and describe how the evaluation was conducted and the results for each problem or opportunity identified. Include a list of criteria and standards used for evaluation purposes Provide tables showing the comparison of alternatives. Conclude with a ranking of all alternatives.

7. Recommended Plan

Describe the utilities systems required to meet current and future mission needs. Prepare tables and maps showing the future recommended utilities alignments and requirements both short-term and long-term. Prepare a table showing the total cost to implement the short-term and long-term requirements

8. Plan Implementation

Describe steps that should be taken to implement the recommended projects. Include coordination needed among installation personnel and off-installation agencies. Develop specific policies, programs, and projects that will implement the future utilities systems plan. To the extent possible, also describe known off-installation projects that will influence the installation. Provide illustrations or maps to supplement the narrative.

Activity		Typical Environmental Concerns of Utility System Construction				
				Duration of Impact		
Phase	Activity	Conditions Potentially Impacted	Type of Impact	Short Term	Long Term	Area of Influence
Site Preparation	Relocation of Existing Improvements	Land Use	Disruption of existing land use, land use quality, relationships and circulation	●		Rights-of-way or potentially impacted by activities
		Economic and Community Resources	Changes in community services infrastructure and local economic base.	●		Adjacent Areas
			Loss of parking revenues	●		Immediate Areas
		Public Content	Disturbance aggravation	●		Adjacent Areas
General Activities	Construction Equipment Operation	Atmosphere (audible quality)	Noise	●		Adjacent Areas
		(air qualtiy)	Dust, odors and internal combustion engine emissions	●		Adjacent Areas
		Earth Resources	Surface disturbances, compaction and contamination from spilled lubricants and fuels	●		Immediate Areas
			Changes in physical characteristics and productivity		●	Immediate Areas
		Water Resouces	Disturbances of physical characteristics and water quality	●		Immediate Areas and Downslope
		Vegetation	Loss of vegetation due to equipment placement and movement	●		Areas with Vegetation
		Wildlife	Changes in population dynamics	●		Adjacent Areas
		Land Use	Increased traffic congestion	●		Immediate Areas
		Economic and Community Resources	Change in natural resources	●		Immediate Areas
		Public Health, Safety and Comfort	Risk of traffic accidents and pedestrian injury	●		Immediate Areas
			Interference with access to emergency facilities	●		Immediate Areas
			Risks to workmen operating equipment	●		Immediate Areas
	Materials Delivery and Handling	Land Use	Increased demands on trasportation routes	●		Adjacent Areas
		Wildlife	Change in population dynmaics	●		Adjacent Areas
	Labor Force	Economic and Community Resources	Employment opportunities (minor: demand for housing, recreation, medical and other services)	●		Nearby Communities
			Direct and secondary increase in retail spending	●		Nearby Communities
		Public Health, Safety and Comfort	Fire Hazard	●		Adjacent Areas
	Disposal of Wastes	Economic and Community Resources	Demands on community facilites	●		Nearby Communities
Clearing		Vegetation	Loss of vegetation	●		Medians and Planting Strips
Earth Work	Pavement Breaking	Atmosphere (audible quality)	Noise	●		Adjacent Areas
		(air qualtiy)	Particulate matter	●		Immediate Areas
		Public Health, Safety, and Comfort	Risk of injury from flying debris	●		Immediate Areas
	Cut and Cover Excavation and Shoring	Atmosphere (air quality)	Particulate matter	●		Adjacent Areas
		Water resources	Alteration of ground water characteristics	●		Adjacent Areas
		Public Health, Safety, and Comfort	Hazard of personal injury and property damage	●		Adjacent Areas
	Excavation by Boring, Jacking, or Tunneling	Water Resources	Change in physical characteristics of groundwater	●		Adjacent Areas
		Public Health, Safety, and Comfort	Risk to workmen below the surface	●		Immediate Areas
		Land Use	Changes in circulation and land use relationships	●		Immediate Areas

APPENDIX C

G TAB/UTILITIES SYSTEMS EXISTING CONDITIONS
MAP DEVELOPMENT

The following series of Tabs (G) or maps are required for inclusion in the Utilities Systems Plan Component. The scales and specifications for producing these maps should be consistent with the size and needs of the installation.

1. Water Supply System. This map indicates the existing sources and capacity of water supply, and shows locations and capacity of wells, entrances on the installation of other sources of supply, storage tanks, main distribution lines with pumping stations, hydrants, valves, metering points, and water treatment plants. All cathodic protection should be shown indicating location of rectifiers, cathode beds, power supply, etc.

2. Sanitary Sewer System. This map shows the existing sanitary sewer system, including location of collection system, manholes with their respective identification number, pumping stations, sewage treatment plants, outfall(s), capacities, cesspools, septic tanks, leaching fields, and independent systems. Pipe sizes, type of material, and direction of flow are required. The type of treatment and effluent discharge and capacity of treatment plants must be indicated, as well as, outfall(s) and final destination of drainage.

3. Storm Drainage System. This map shows the existing storm drainage system, including location of pipes, manholes with their respective identification number, catch basins, inlets, pumping stations, culverts, outfalls, french drains, and tile fields. Industrial waste disposal systems should be shown if industrial waste (including aircraft cleaning fluid) is handled through the storm drainage system. Size of pipes, type of material, and direction of flow should be indicated. General drainage features such as drainage divides, water courses, and major drainage ditches could be shown. The final destination of drainage (ocean, river, creek) shall be indicated. Special conditions such as snow storage, total rainfall for each month (average for a period of record), flood control facilities, and frost conditions, must be shown.

4. Electrical Distribution System. This map shows the sources of electrical power and the installation's primary distribution, street lighting systems, and apron maintenance lighting system. All poles and towers should be shown with their identification numbers. Information is to be including concerning:

- Commercial power supply
- Installation generating plant
- Voltage regulators
- Maximum demand
- Primary distribution system
- Auxiliary power

5. Central Heating/Cooling Systems. This map will show the location, type and capacity of central heating and cooling plant(s) and fuel storage. The size, pressures and capacities of the distribution and return lines should also be included.

6. Natural Gas Distribution System. This map will show the existing system, including distribution system and storage parts; name of suppliers, size, type, and pressure (underground or above ground) of distribution lines; the location of expansion loops, valves, meter pits, odorizer, and pressure reducing stations; and, the gas requirements expressed in cubic feet per hour for each facility tied into the system (except housing areas).

7. Street Lighting System. Street and apron maintenance lighting systems including the types of system (series or multiple); method of control; rating of regulators and/or transformers' type of light fixture poles; characteristics of light conductors; and location, type, and rating of luminaires should be shown. Apron lighting map should also show direction of beams.

8. Liquid Fuel System. This map will indicate the information relative to the existing liquid fuel system in terms of the source of supply, location and capacity of all facilities for the storage and distribution of AVGAS fuel, MOGAS fuel, jet fuel, diesel oil, and luboil at the installation.

9. Cathodic Protection System and System Details. These maps consolidate all utilities systems, structures, and facilities that are subject to electrochemical corrosion within the confines of the installation or affecting those within the confines of the installation. Sizes and materials of mains/lines should be identified along with (if information is available)

any coating or insulation that covers them. These detail maps(s) show utilities, structures, of facilities identified as having cathodic protection system and details of ground beds.

10. Central Aircraft Support Systems (C&SS) (Optional). If required, this map shows the consolidated set of utility systems that serve the airfield apron and related areas for servicing of aircraft. These systems include electric, compressed air, water systems, in addition to the base-wide systems.

11. Industrial Waste Drain System (Optional). This map should be provided as required to designate separate drainage systems, particularly for industrial complexes, to carry away discharges from industrial processes, e~ Where such a system exists, the location, sizes and types of pipe, type of treatment and effluent discharge treatment capacity and final destination of drainage should be shown.

12. Composite Utility Systems. This is a consolidation of the information graphically depicted on the existing utility systems maps described above shown on one map.

APPENDIX D. REFERENCES

Air Force Manuals (AFM) and Regulations (AFR)

AFM 86-2	Standard Facility Requirements
AFR 86-4	Base Comprehensive Planning
AFM 88-10	Water Supply
AFR 88-15	Criteria and Standards for AF Construction

Army Technical Manuals

TM 5-800-1	Construction Criteria for Army Facilities
TM 5-803-4	Planning of Army Aviation Facilities
TM 5-811-1	Electrical Power Supply and Distribution
TM 5-811-2	Electrical Design Interim Electrical-System
TM 5-813-1	Water Supply, General Consideration
TM 5-822-2	General Provisions and Geometric Design for Roads, Streets, Walks, and Open Storage Areas
TM 5-813-4	Water Supply: Water Storage
TM 5-813-5	Water Supply: Water Distribution System
TM 5-813-6	Water Supply for Fire Protection
TM 5-814-1	Sanitary and Industrial Wastewater Collection, Gravity Sewers and Appurtenances
TM5-814-2	Sanitary and Industrial Wastewater Collection, Pumping Stations and Force Mains
TM 5-814-3	Domestic Wastewater Treatment
AR 210-20	Master Planning for Army Installations

Other Publications

B-1B Hydrant Fueling/Centralized Aircraft Support System Overview: Capt. Mike Kaleda, HQSAC/DEEQ, March 1987.

Fort Bragg Master Plan Phase II, January 1986.

Comprehensive Plan McClellan Air Force Base, August 1987.

Wright Patterson Air Force Base Statement of Work for Utility Inventory, Mapping and Planning, Draft July 1988.

Water Supply and Sewage, Ernest W. Steel, McGraw-Hill, 1960.