Utility systems provide the basic infrastructure of power, communication, water and sewer services necessary for the operation of an installation. They have played a key role in determining the visual character 6f installations. First, their location and alignment have exerted a major influence on the historical development pattern of installations and remain as primary considerations in determining the feasibility and location of future development. Second, street rights-of-way have traditionally been used for the location of most utility systems. This provides an efficient distribution system that serves development fronting on both sides of the street, but results in a cluttered and unattractive streetscape when transmitted on overhead lines. Various planning and landscape design techniques can serve to reduce these negative impacts on the visual quality of military installations.

Section I:

Observations and Objectives.

13-1.
Typical Problems.
A. General Location.
Major reasons for locating utilities within street rights-of-way include minimizing utility easements, land clearance, capital investments and operational costs while maximizing the ease

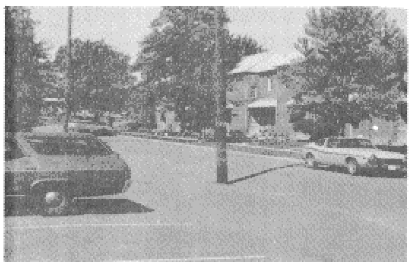


Figure 13-1.

of access for maintenance and repair. However, there are also problems associated with siting utilities within the street right-of-way, including disruption of traffic caused by repairs and the clutter or unsightliness of above grade facilities along the streetscape (*figs. 13-1 and 13-2*).

B. Overhead Utilities.
The alternatives of siting utilities underground, behind facilities or behind plant screens have generally not been considered. Underground distribution may be more expensive initially, but it reduces breaks, does not interfere with trees, and eliminates the clutter of poles with overhead transmission lines.

Figure 13-2.

Figure 13-3.

Recently developed cable burying techniques have reduced costs substantially. Even if underground distribution cannot be justified, the opportunity usually exists to minimize the detrimental visual impact by proper location, screening and detailing.

C. Storm Drainage.
An inadequate or poorly designed storm drainage system is another problem observed at many installations. Often open drainage ditches or channels are improperly designed, resulting in a number of problems including: soil erosion, unsafe conditions, and recurrent and costly maintenance problems (*fig. 13-3).*

13-2. Objectives.

A. Minimize the Visual Impact of Utilities.
Utility systems should be designed with a concern for their appearance. Past emphasis has been concerned almost solely with cost and efficiency. A pure functional expression of utility systems can be attractive. However, utility poles, above ground steam lines and open storm drains are often unsightly and detract from the appearance of an installation. These detrimental effects can be ameliorated through appropriate location, screening and detailing of utility systems.

B. Minimize the Environmental Impact of Utility Systems.
Utility systems should be designed to minimize adverse environmental impacts. Such concerns will also contribute to an improved visual environment. In particular, careful storm water drainage design should minimize soil erosion which can damage natural vegetation as well as be unsightly.

C. Design Utility Systems for Ease of Maintenance and Repair.
The most cost effective system is not always the one that costs the least initially. The location and detailing of system components can greatly affect maintenance and repair which are a large part of life-cycle costs of any system.

Section II:

Design Guidelines.

13-3. Appearance.

A. Power and Telephone.
Unsightly overhead utilities should be relocated underground wherever possible; when not possible, the negative visual impact of these facilities should be minimized by location, alignment, design and screening.

1. Overhead Transmission Lines. These facilities should be located compatibly with the landform and land use pattern of the installation; they should be screened from major viewing points by plant material and topographic features to minimize their silhouette and long views of the system; and they should have a simple and transparent design character.

a. *Land Use.* Overhead transmission lines should be aligned along edges of land use areas to avoid dividing an area and creating gaps or unusable areas; alignments should avoid scenic areas (*fig. 13-4*).

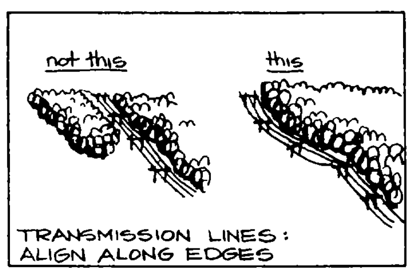


Figure 13-4.

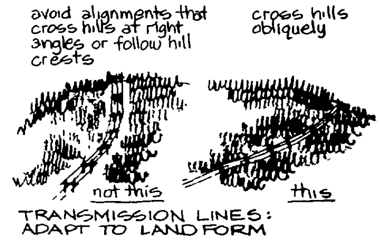
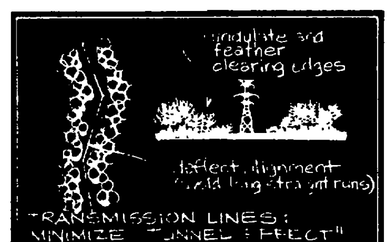


Figure 13-5.

b. Landform. Overhead transmission lines should conform to natural landforms which should be utilized to screen them from public view; hills should be crossed obliquely rather than at right angles; avoid alignments along hill crests or steep grades that expose facilities to view (*fig. 13-5*).

c. View Screening. Minimize long views and silhouette views of overhead transmission lines from along major roads and other public viewing areas. Avoid the "tunnel effect" of long, straight, uninterrupted views along the alignment by clearing vegetation only within the right-of-way that threatens the over-

Figure 13-6.



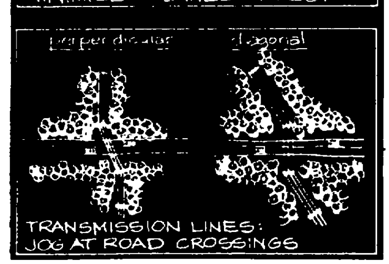


Figure 13-7.

head lines. Jog the alignment at road crossings and periodically undulate and feather plant materials along the edges of the right-of-way (*figs. 13-6 and 13-7).*

2. Distribution Lines.
Power distribution lines should preferably be located underground; if overhead, they should be located out of view from main public visibility areas or screened to be as unobtrusive as possible.

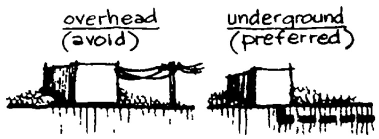


Figure 13-8.

a. Underground. Use underground distribution lines wherever possible, especially along major roads and silhouette exposure areas such as street crossings and building feeder service (*fig. 13-8*).

b. Overhead. Avoid alignments along major public circulation ways and, instead, use minor streets, alleyways or placements

Figure 13-9.

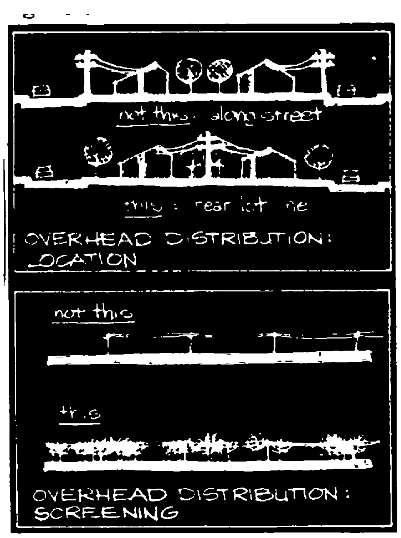


Figure 13-10.

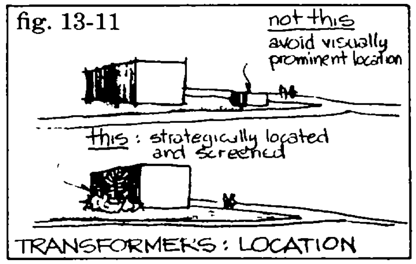


Figure 13-11.

related to vegetation and topography that screen views and minimize their visual impact (*fig. 13-9*). Use trees to provide a backdrop to minimize the silhouette of facilities against the sky (*fig. 13-10*). Reduce the length of visible segments by interrupting views with trees or offsetting the location behind trees and topographic features where long views of the lines along a road would otherwise occur. Use poles and line attachments which have a simple design and whose color, materials and general appearance blend harmoniously with their surroundings. Minimize the number of poles and pole height while also making poles multi-functional, i.e., power, telephone, street lighting, etc.

3. Substations and Transformers. They should be located and designed to minimize their visual impact and be compatible with the character of their setting. Substations are best located in industrial use areas rather than in major pubic circulation areas (*fig. 13-11*). Substations and transformers should be screened from public view by means of plant materials, topography and enclosure walls *(figs. 13-12 and 13-13*). The noise generated can be muffled by using plants, earth berms and enclosure walls.

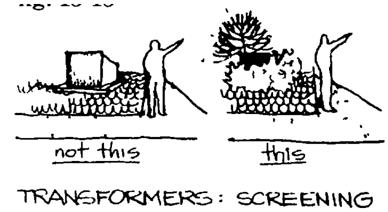


Figure 13-13.

B. Sewer and Water.
All sewer and water lines should be underground. Sewer and water treatment facilities should be screened from views of major roads and other installation facilities by the use of earth berms, plant materials, fencing and/or enclosure walls. A water storage tank that has visual strength in its form can be used as a focal point or identifying landmark that can aid in providing a sense of orientation

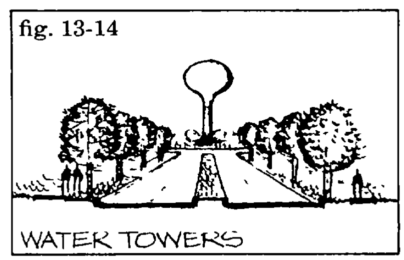
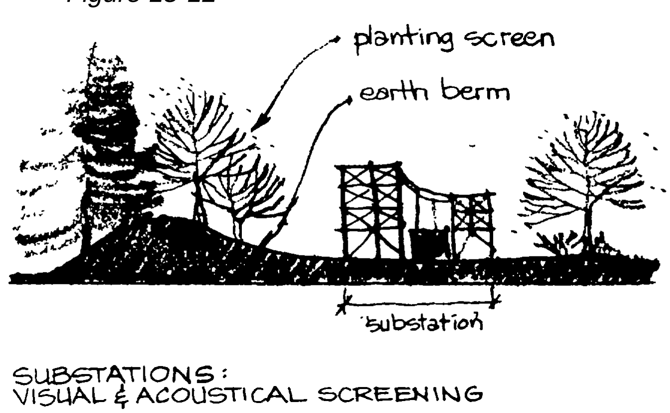


Figure 13-14.

Figure 13-12



within an installation (*fig. 13-14*). Fire hydrants should be highly visible and free of any screening; they should be a uniform design throughout the installation; avoid decorative painting of fire hydrants.

C. Storm Drainage.
Installation storm drainage systems should be appropriate to the character of development which they serve (*fig. 13-15).* Storm drainage systems in densely developed areas require the use of curbs, gutters and underground lines. Storm drainage systems in relatively low density areas should be handled

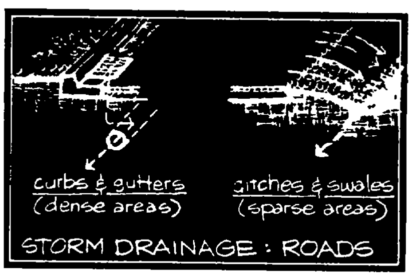


Figure 13-15.

by drainage swales and ditches which are compatibly contoured into the natural landform. Potential opportunities to create permanent ponds as special landscape features or temporary storm water retention ponds should be considered when designing the storm water control system of an installation (*fig. 13-16*). Temporary retention ponds, if designed with care, can be utilized during the normal, or dry stages, as recreational areas such as athletic fields or as portions of a golf course. Temporary retention ponds should normally be planted in grass.

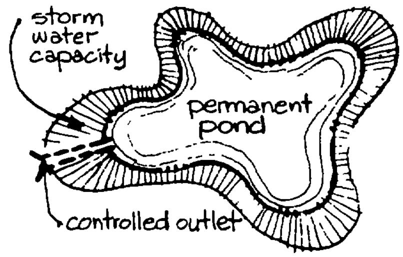


Figure 13-16.

13-4.
Environmental Impact.

A. Power and Telephone.
Minimize negative environmental impacts in the clearance and construction of these facilities. Select route alignments that will maximize preservation of the natural landscape and conserve natural resources. Avoid steep slope areas with high erosion potential and areas of water, marshlands or wildlife concentration. Also promote joint-use or common utility line easements to reduce the number of individual system rights-of-way. Clear only vegetation that physically threatens the transmission lines and avoid use of spray defoliants. Employ adequate erosion and sediment control practices to minimize soil erosion during construction.

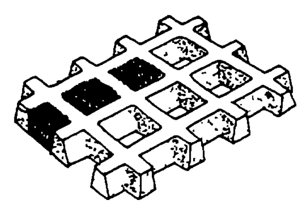
B. Sewer and Water.
Minimize negative environmental impacts associated with sewer and water line construction and treatment facilities.

1. Treatment Facilities.
Sanitary sewer treatment facilities should provide adequate treatment of effluent to be released into a receiving stream that is capable of absorption; furthermore, treatment facilities should be designed with direct noise baffling, plant material and/or earth berm screening to reduce noise. Consider potential spray irrigation disposal of treated effluent, particularly for recreation areas such as golf course and recreational fields.

2. Alignment. Minimize negative environmental impacts associated with alignment and construction of underground sewer and water lines. Consider low pressure sewer line pumping systems utilizing street rights-of-way in areas where gravity sewer lines would cause excessive site clearance and regrading to accommodate an alignment other than in the street right-of-way.

C. Storm Drainage.
Design storm water drainage systems to protect downstream watersheds and waterways from flooding and silting.

1. Each project should be designed so that the surface water leaving the site after the project is complete is not significantly greater than that leaving prior to development of the site.



PERVIOUS PAVING BLOCKS

Figure 13-17.

2. Paved surfaces should be the minimum required and previous areas of planting should be maximized to lessen storm water runoff. Consideration should be given to the use of pervious paving or paving blocks that permit grass to grow through them, as measures to reduce storm water runoff (*fig. 13-17*). While currently the maintenance and durability characteristics of these materials is not adequately proven, they could be tested and evaluated in controlled sections on some projects to determine their suitability prior to any widespread application throughout an installation. Careful consideration should, however, be given to the potential hazards such paving systems night pose for handicapped individuals.

3. Artificial drainage courses, particularly outlet waterways, must be constructed of materials suitable to the quantity and velocity of storm water runoff. Where possible, they should be vegetative channels. Plant growth can be promoted by the addition of jute matting or paper protective linings (*fig. 13-18*).

4. Outlet waterways with slopes or flows greater than that which can be safely vegetated should be treated with riprap or gabion

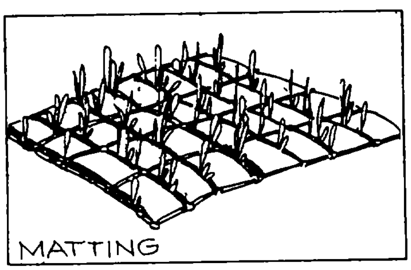


Figure 13-18.

mattresses. Concrete channelization should be avoided (*fig. 13-19*).

5. It is normally appropriate to perform a soil survey to predict the behavioral characteristics of areas yielding, receiving or impounding runoff.

6. Storm water management should be considered for each watershed rather than the area limited to new development. It is

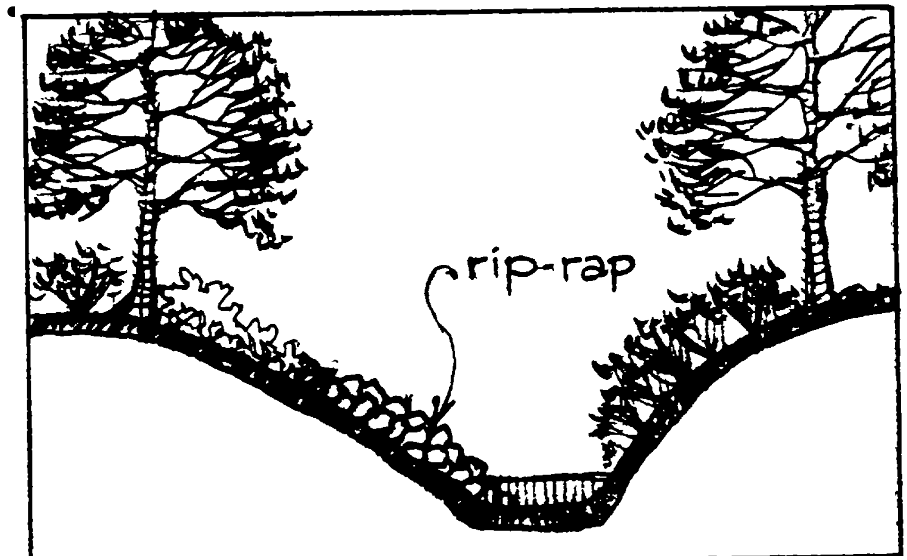


Figure 13-19.

usually advantageous to combine storm water management for several small developments in one facility.

7. Proper erosion and sediment control practices should be followed for disturbed areas during construction of all facilities within the installation. These include seeding, sediment control basins and structures.

13-5.

Maintenance and Repair.

Utility systems should be designed to minimize required maintenance and repair, provide access for maintenance and repair vehicles and minimize the disruptive effects of maintenance and repair operations.

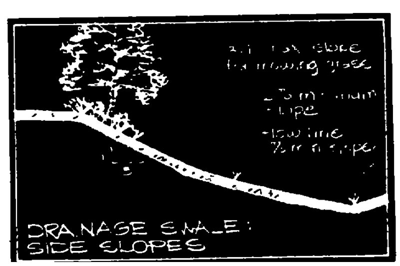


Figure 13-20.

A. Care should be taken to correct minor erosion problems early, before they develop into serious ones.

B. Storm water management ponds should be designed with side slopes flat enough to accommodate normal grass cutting equipment and with bottoms steep enough to allow complete drainage (*fig. 13-20*).

C. Storm water management ponds should be constructed with low-flow outlet channels suitable to carry flows without causing erosion.