SITE PLANNING FOR COMMERCIAL BEEF CATTLE FEEDLOT OPERATIONS

BY

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CHAPTER 1

INTRODUCTION

Beginning in the Ohio Valley and Corn Belt regions of the United States in the late 1700's, cattle feeding has been a major enterprise to meet the demand for beef in an ever increasing population.

Cattle production has been, since the beginning, primarily a frontier and transient industry, constantly in a state of change and geographical relocation. The great westward push came in the 19th century. By 1800, the center of the cattle country was west of the Alleghenies, in Ohio and Kentucky; in 1860, it was in Illinois and Missouri; and by the 1880's, it was in the Great Plains. Forced to move by increasing urban development, the cattle industry has settled in the less densely populated regions of the U.S. The commercial feedlot was a direct result of this pressure from urban development.

However, it was not until the 1950's, that the beef cattle feeding industry began to experience drastic changes in its method of production, mainly the development of the large commercial feedlot. This, new method of mass, finished beef production is only approximately 25 years old. Advances in feeding and equipment technology have allowed the size and number of commercial feedlots to increase several fold since the 1950's.

Today, in 1976, this industry comprises a considerable land use in areas that are conducive to mass, finished beef production, largely the sorghum producing, mild, dry climate and less populated areas of the mid and southwestern United States.

Commercial beef cattle feedlots are defined as any feeding operation which has a capacity of 1000 head or more at any one time in a confined area. This description and definition is frequently used by the United States

Department of Agriculture in reporting cattle statistics and by the U. S. Environmental Protection Agency, in establishing industry regulations.

Statement of Problem

Commercial beef cattle feedlot operations have been the subject of public concern and environmental legislation in recent years. This concern was brought forward by an environmentally conscious public, and because poor feedlot manure management practices were resulting in polluted streams and water courses.

Since the 1960's, local, state and federal legislation has been enacted which restricts certain feedlot manure management practices and requires commercial feedlots to implement water pollution control systems in their operations. The commercial feedlot industry has adjusted and presently almost all commercial feedlots are operating within the scope of local, state and federal environmental pollution control regulations.

As a result of the environmental water pollution, previously caused by the feedlot industry, the public's image of commercial cattle feedlots remains somewhat less than favorable. This is partly due to visual, perceptual and operational characteristics of the feedlot operation. It is unfortunate that these conditions exist when site planning techniques and design concepts are available to effectively eliminate and minimize most of the problem areas.

Scope and Objectives of Study

The scope of this study involves a review of the factors that have contributed to the growth and development of the commercial beef cattle feedlot industry. These factors include historical, economical and environmental considerations.

The objectives of this study are: 1) to review and analyze existing physical site conditions, characteristics and design criteria of the commercial beef cattle feedlot industry, to determine specific site planning and design problem areas; 2) to illustrate site planning techniques and design concepts that can be applied to commercial feedlot sites which will enhance functional operation, create a positive public image and maintain a harmonious relationship with the surrounding environment; 3) to provide site planning guidelines to feedlot owners and operators who are interested in developing functional and visually appealing commercial feedlot operations.

Limitations of Study

This study is not intended to be a technical journal on commercial beef cattle feedlot design, layout or construction. It is not the intent of this study to propose or recommend environmental pollution control legislation or regulations. Alternative methods and systems of waste manure disposal and liquid runoff are not within the scope of this study.

This study is limited to site planning for conventional, open-air, commercial beef cattle feedlot operations. The site planning techniques and design concepts, illustrated in this study, may or may not be adaptible to every site, existing or proposed. However, the site planning guidelines in this study should provide assistance in individual site development.

CHAPTER 2

SITE PLANNING FOR COMMERCIAL BEEF CATTLE FEEDLOT OPERATIONS

As with any type of development upon the landscape, commercial beef cattle feedlots should be planned and designed for efficient operation, visual quality and minimum impact on the surrounding environment. Commercial feedlot operations are especially in need of effective site plans as they are often associated with the public image of 'polluters' and 'nuisances' in the environment.

To accomplish these objectives, an analysis of influencing factors must be completed in order to determine the best methods of integrating the operation into the landscape. This process of review and analysis is known as site planning.

Site Planning Process

The site planning process for commercial feedlot operations does not differ significantly from other types of development. It involves the consideration of three basic planning phases:

1) Collection and recording of information.

2) Analysis of information to determine influential and pertinent factors affecting planning decisions.

3) Formulation of the development plans.

Data collection encompasses information relating to the operation, such as; historical, social, economic, political and environmental considerations. In addition, site selection criteria must be analyzed to choose suitable locations for the operations. Individual sites should be reviewed and analyzed by gathering specific data including:

1) Site Survey Data

   a. property line survey

b. easements and rights of way

c. location of roads; type, classification and condition

d. location and volume of utilities such as water, power and gas

e. aerial photograph of a workable scale; (1" = 200 or 400')

f. contour map with 2, 5, or 10' intervals with slope indications

g. site surface conditions

2) Soils and Geological Data

a. depth of topsoil and subsoil

b. location and classification of soil types

c. depth to bedrock

3) Hydrological Data

a. surface runoff patterns and rates

b. groundwater location

c. location of streams, lakes, ponds and wells

d. floodplain location

4) Vegetation Data

a. existing vegetation types

b. location of existing vegetation

5) Climatic Data

a. rainfall amounts and intensity

b. wind velocities and prevailing direction

6) Land Use Data

a. existing and future zoning

b. present and future land use

c. development trends and patterns

d. access to transportation routes

7) Perceptual Data

a. views into and upon the site

b. areas of noise, dust and odor generation

The next step in the site planning process is the analysis of this information to determine the potentials of the site for adequately accommodating the feedlot operations. This information should be considered along with a thoroug review of the feedlot's functional operations to determine use patterns and capabilities as influenced by the site such as:

1) Function and characteristics of the operation

2) Traffic circulation patterns

3) Spatial requirements

4) Equipment types

After a thorough review and analysis of all influencing factors, design studies are conducted to determine the best functional and environmental relationships in terms of site organization, land forming and plant material arrangement. From the preliminary design studies, the final development or 'master plan' is formulated to serve as the guide for construction. The 'master plan' can also provide a basis for cost estimates, capital investment requirements and construction feasibility.

CHAPTER 3

HISTORY & DEVELOPMENT OF THE BEEF CATTLE FEEDING INDUSTRY

Beef cattle produced in the grassland country of the United States are not considered as a favorable quality of red meat that is demanded at the market place by the American consumer. Therefore, a considerable number of beef cattle coming from the grasslands of the Nation, are confined to feedlot operations and fed prepared feed rations of corn, milo, alfalfa and forage crops to improve the weight and quality of the beef animal carcass. This process produces the high quality, red meat that is demanded by present populations and has led to the development of the commercial feedlot industry.

Cattle Production in the Ohio Valley

Beef cattle feeding, in the United States, began in the Ohio Valley in the late 1700's. Rich, fertile, farm land produced large corn crops, which the early settlers planted mainly to produce corn whiskey. However, when the Government of the U. S. would not allow the settlers to make their own whiskey, the corn crops were fed to cattle and hogs as an alternative method of marketing. (1)

Farms in the Ohio Valley were relatively small operations when compared with todays standards. An average Pennsylvania Dutch farm was 25 to 30 acres, with some larger operations reaching 300 to 400 acres. Beef cattle were fed and marketed by the individual farmer with grass and grain crops raised on his own land. The most efficient method of finishing beef cattle was 'soiling' or stall feeding. Cattle were kept in stalls or sheds to provide protection from the weather. The stalls and sheds kept the cattle from roaming the fields in search of forage and thus losing weight. Feed was provided at daylight, noon and before sunset. (1)

Some of the early day cattlemen fed straight corn rations, but the wiser ones introduced roughage (corn shucks, stalks & straw) to reduce the amount of corn needed to finish the cattle for market. This method of feeding and finishing beef cattle was the beginning of the cattle feeding industry in the United States.

In 1810, it is estimated that approximately 700 beef cattle were finished in the Ohio Valley. By the late 1820's, between 4000 and 7000 cattle were finished and marketed in the eastern states of New York and Pennsylvania. By 1831, the number was approximately 12000, and by 1834, the corn and beef cattle industry was firmly settled in the Ohio Valley which had become the center of beef cattle production in the Nation. (1)

As the population of the Nation grew, the demand for beef and beef products increased. The demand was growing especially for high quality, corn fed beef, rather than grass finished cattle. Most of the cattle in the Ohio Valley were raised by the farmers, however, some of their stock was obtained from the Great Plains region. In 1820, cattlemen from the Ohio Valley began traveling to the Mississippi Valley in search of feeder cattle and to expand their operations. This search for feeder cattle eventually led to the importation of Texas and Indian Territory cattle to the Ohio Valley region. (1)

<u>The Mississippi Valley Cattle Feeding Industry</u>

With the source of feeder cattle being to the south and west of the Ohio Valley, the cattle feeding industry began to move westward. Illinois soon became an active feeding center for Texas and Indian Territory cattle. The Missouri cities of Independence, Westport and Kansas City became the largest markets for finished cattle. The center of the cattle feeding industry had moved from the Ohio Valley, west to the Mississippi Valley, in a few years. (2)

The cattle trade from Texas to the Ohio and Mississippi Valleys grew significantly from the 1840's up to the beginning of the Civil War. However, the war put a halt on the trade. Union forces blockaded the gulf ports and the Confederate armies drained Texas of able-bodied men, who had been raising cattle. As a result, the Longhorn cattle of Texas went relatively unnoticed during the Civil War years. The Longhorn cattle in Texas grew to a population of three and a half million in 1860 and reached six million by 1865. (2)

The Gold Rush

The discovery of gold in California and Colorado in 1849 sent people rushing west to seek fortune and fame. Soon a demand for beef on the West Coast and mountain regions was apparent. Gold fever helped to pull the cattle industry, the railroads and settlers westward at an increasing pace. (2)

The Great Texas Trail Drives

Although Texas had an over abundance of cattle in the 1860's, the Civil War had reduced the supply of beef in the North drastically by 1865. A high grade, matured beef animal worth five dollars in Texas cow country would bring fifty dollars in the North. This was the impetus for the beginning of the Great Trail Drives from Texas to Kansas railheads. (3)

By 1867, the Kansas, Pacific Railroad had been completed to Abilene, Kansas. Joseph G. McCoy, an Illinois stockman, visited Abilene in 1867 and built facilities for holding, loading and shipping cattle by railroad to the eastern markets. In the summer of 1867, 35000 Texas cattle came to Abilene. (2) Over the next two decades, millions of Texas Longhorn cattle made the 'trail drives' from Texas to Kansas over the Chisholm and Western Trails to meet the rising demand for beef in the Nation. (4)

Cattle Production on the Open Range

Most of the beef cattle produced in the United States up to the 20th century were finished in the open-range country on native grasses. The open-range cattle finishing had one serious flaw in that it supplied an uncertain quantity of red meat and of rather inferior quality. This type of cattle production could survive only as long as the cattlemen had unlimited access to open-range grasses, water and trails to market. If these elements became restricted, the system would not be able to meet the ever-growing demand for beef and at a reasonable cost to the consumer.

Settlers and farmers, in the 1880's, began to move into the open-range territory in increasing numbers, bringing with them barbed wire, windmills, plows and grain crops, all of which tended to restrict the open-range. The hostile climate of the 'Great American Desert' also had drastic effects on cattle production. Winter blizzards, summer droughts and disease cut hard at cattle production on the Great Plains. The cattlemen of the Plains region had to devise a system of production that would more effectively meet the challenges of a hostile climate, advancing settlers and an industrial nation's increasing demand for high quality beef. (5)

Cattle Production in the Early 1900's

Several developments in the early 1900's helped to bring about changes in beef production. Improved transportation systems were making it easier for finished cattle to reach markets and move beef products to the consumer. Diseases were beginning to be controlled by science and new forage crops such as sorghum and alfalfa were supplementing native grasses for feed. As the open-range became more restricted, the reliance on supplemental feeds grew.

Farmers on the Great Plains tried dry farming in the early 1900's, however, the dry climate forced many to raise and feed livestock as a supplement to dry farming. This practice came to be known as ranch farming. Ranch farming was the predominant form of cattle production on the Great Plains between the years 1900 and 1950. (3)

This system of cattle production permitted the production of more beef on fewer acres as farmers and cattlemen installed water facilities, raised alfalfa, corn and sorghum for feed. Silos were being used to store forage crops for winter feed. These methods, plus improved breeds of cattle and closer supervision of the herds were producing the higher quality, fed beef that was in demand. (3)

One of the most significant technical changes for the Plains cattlemen was the development of the truck for the transportation of cattle. Shipping time and weight losses were much less by truck than by railroad. The truck allowed the exploration of new markets and thus greater profits. The improvement of the refrigerated railcar and truck also allowed beef cattle to be processed closer to the producer and shipped to the consumer with less spoilage. (3)

Beef Consumption (1900 to 1950)

Despite the changes in cattle production in the Great Plains which produced more beef per acre and of a higher quality, the supply could not keep pace with the rising demand. The reasons for this situation were several fold. The population of the Nation was increasing rapidly, while beef production was increasing but at a slower rate.

At the close of the 19th century, beef consumption in the United States was 72.4 lbs. per capita per year. At the beginning of World War 1 in 1914, beef consumption was 62.3 lbs., rising to 75.8 lbs. under the stimulus of war and financial assistance from the Government. The Great Depression of 1929 caused consumption to drop to 53.3 lbs. by 1933. By 1947, consumption was 80.4 lbs. caused by full urban employment, highest wages in history and a population inclined to eat beef. Inflation in 1949 caused prices to rise sharply and consumers cut back to 71.4 lbs. in 1950 and 62.7 lbs. in 1951. But by 1955, each American ate 91.4 lbs. of beef per year. (3)

As these figures indicate, the demand for beef fluctuated in the first half of the 20th century, but the trend was that of increasing demand. Even with Government subsidies to cattle producers and improved methods of production, the supply was not meeting the demands.

Development of the Commercial Feedlot

Cattlemen and beef producers in the 1950's, to adapt to urban development and the increased demand for high quality, grain-fed beef, began to develop the concept of large, commercial beef cattle feedlots. This concept involved the building of feeding facilities to handle large numbers of cattle in a single operation and location. The feedlot operation was, in effect, specialization within the industry and an attempt to stabilize production and guarantee a specific volume of finished cattle to the market. The essential feature of a feedlot is its inherent predictability, which lends itself to a relatively standardized management formula. (6) These aspects of finished beef cattle production were non-existent in the traditional ranch farming method that prevailed through the mid 1900's.

Major factors contributing to the change in cattle production were increased national and foreign beef demand, growing populations, development of large retail food store chains and processing techniques. The availability of grain crops in other parts of the U. S., technological advances and new management practices that were relative to large scale cattle feeding operations also promoted the growth of the commercial feedlot. (7)

Finished beef cattle production, prior to 1950, was centered in the Corn Belt region of Iowa, Nebraska and Illinois; by individual farmers and feeders instead of commercial feedlots. Most of the expansion of the cattle feeding industry in the 1950's took place in the fertile valleys of Southern California. However, in the 1960's, the expansion moved into the Central and Southern Great Plains, due mainly to the development of hybrid grain sorghums in this area. Texas, Nebraska, Oklahoma, Kansas and Colorado all showed increases in the number of commercial beef cattle feedlots. Texas and Nebraska had the largest increases in commercial feedlot numbers during the 1960's. (3)

During 1970, there were 2,242 commercial beef cattle feedlots operating in the United States. These feedlots were responsible for more than 55 percent of the Nation's 25 million head of marketed fed cattle. Over half of the Nation's commercial beef cattle feedlots are located in Nebraska, Texas, Kansas, Colorado and California. Iowa is the Nation's leading beef producing state, but relies largely upon the individual feeder and not the commercial feedlot. Nebraska is second in beef production, followed by Texas, California, Colorado and Kansas, respectively. In 1970, these six states accounted for 69 percent of all fed cattle marketed in the United States. (7)

Figure 1 indicates the major fed beef producing areas and commercial feedlot locations in the United States on a basis of fed cattle marketings from 1959 to 1969. Finished beef production in the United States, closely parallels the corn and sorghum producing areas, as these two grains crops are the most preferred sources of feed rations for beef cattle, Figure 2. (7)

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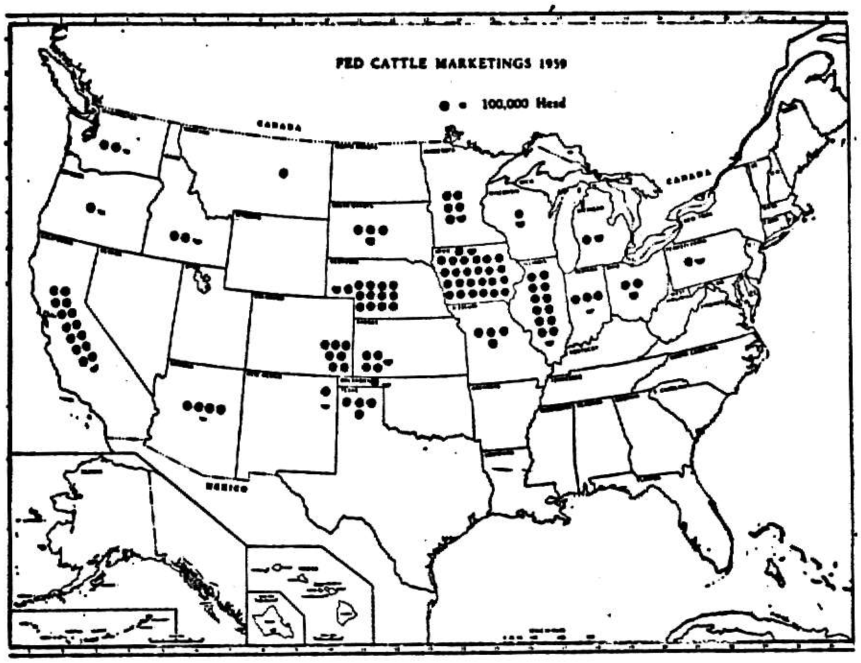


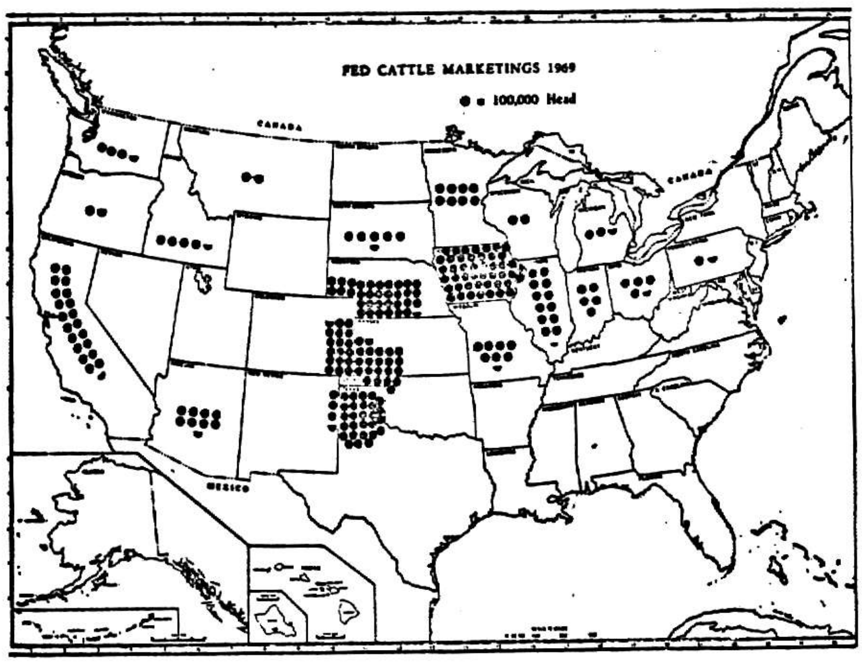


Figure 1. Major Finished Beef Cattle Producing & Commercial Feedlot Areas in the United States

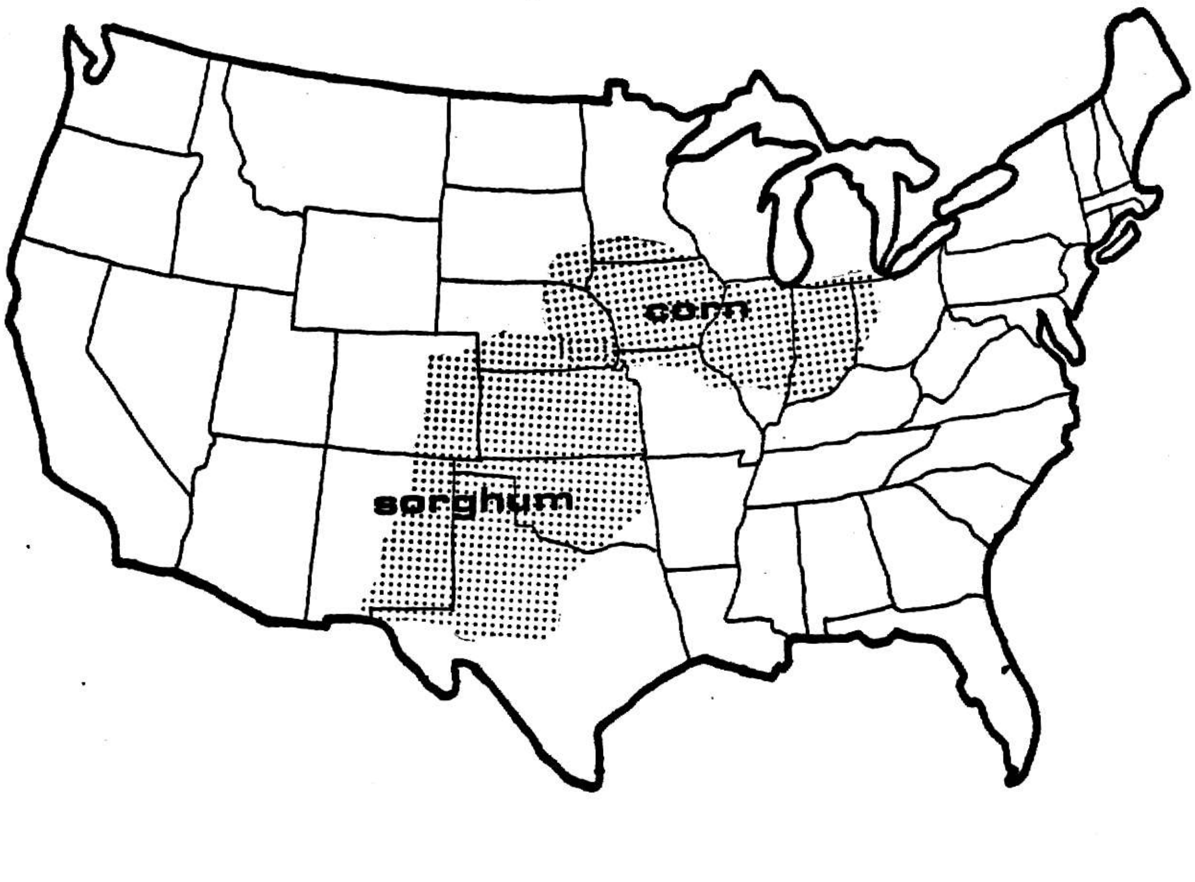


Figure 2. Corn & Sorghum Producing Areas in the United States

Most of the beef cattle in Texas are fed in the Northern Panhandle region. In Oklahoma, the Western Panhandle is the area of the most cattle feeding activity. Northeastern New Mexico, Southeastern Colorado and Southwestern Kansas are also areas of intensive beef production. This sorghum and beef cattle producing region is frequently referred to as the 'Beef Belt', Figure 3. Not only has cattle feeding increased rapidly in this area, but the beef packing industry and related agri-business enterprises are also locating in this region to complement the finished beef cattle producing industry. (7)

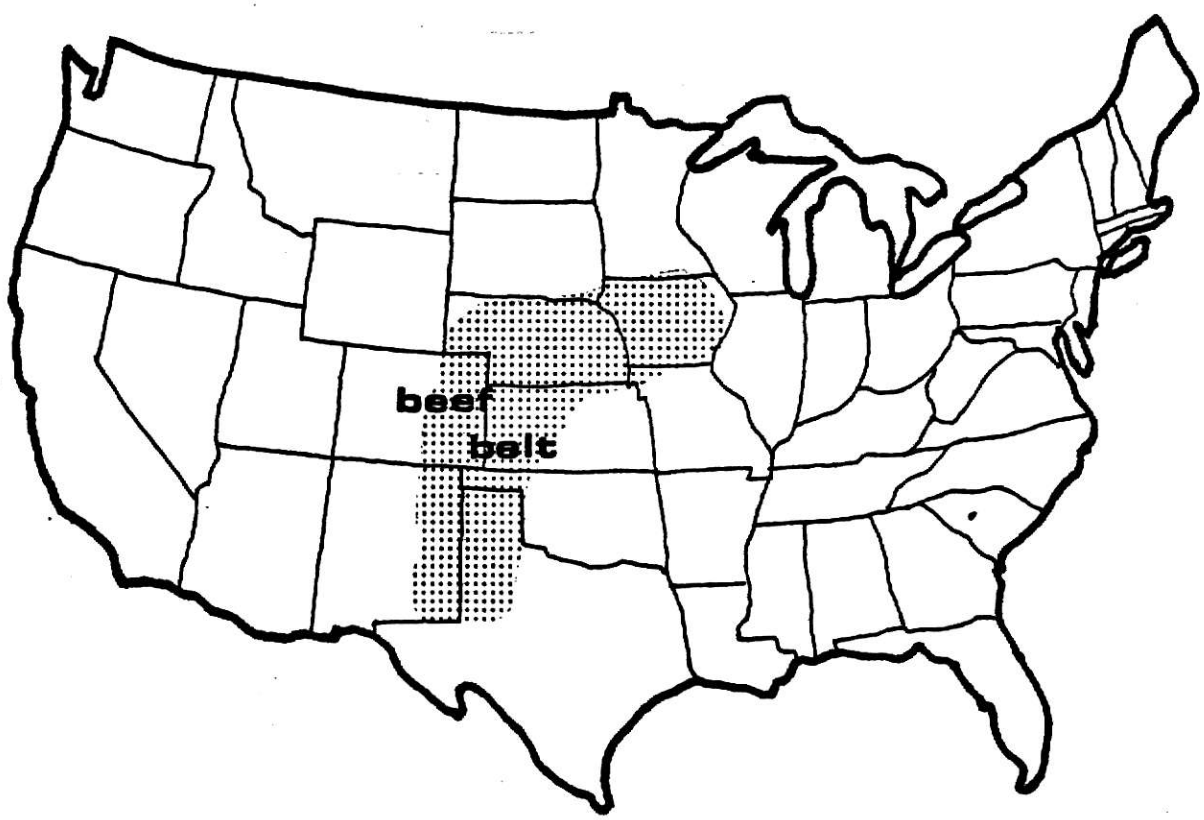


Figure 3. The Beef Belt

CHAPTER 4

THE ECONOMIC POSITION OF THE COMMERCIAL BEEF CATTLE FEEDING INDUSTRY

The cattle industry in the United States has been a dominant force in the American economy ever since the early Colonies. However, the cattle feeding industry came into its own in the 1950's. As with any industry, it has suffered some economic setbacks, but has always recovered to increase production to meet the growing demand for beef.

In the United States free enterprise system of economic production, the cattle feeding industry is one of the few industries which cannot control the market price of its product, grain-fed, finished beef cattle. Being an agricultural oriented industry with the demand for its product being largely urban, the market price is controlled by consumer buying power, consumer demand, wage levels, employment rates and sometimes by the Government. In addition to these economic factors, climatic conditions and grain prices can directly affect market prices. The cattle feeding industry is governed by the economic law of supply and demand. The market price of cattle continually fluctuates, which makes it a very competitive industry, operating on narrow profit margins.

The World Market

The World's cattle population in 1966, according to Federal Agricultural Organization estimates, reached close to 1,200 million head, or approximately one beef animal for every three persons. (8) Total World meat production in 1967 was approximately 34 million tons. (8) In 1974, the World's cattle production had increased to 1,350 million head and total World meat production was 37.3 million tons. (9)

Six countries of the World have over one-half of the cattle population: India, the United States, the Soviet Union, Brazil, China and Argentina respectively. The United States, the Soviet Union, Argentina, France and Brazil produce the bulk of the World's beef. However, on a world-wide basis, only a small portion of the total amount of beef produced is grain-fed. (8)

The United States Market

The United States, with roughly 10 percent of the World's cattle, produced approximately 27 percent of the World's beef in 1967, making it the World's leading beef producing nation. (8) In 1974, the U. S. cattle population was 131.8 million head, which produced 10.7 million tons of beef or approximately 32 percent of the World's beef production. Figure 4 indicates beef production in the United States since 1950.

Trends in the U. S. cattle slaughter, from 1955 to 1975 are shown in Figure 5. In 1955, fed cattle marketed totaled 8.5 million head or approximately 21 percent of the total cattle slaughter of 40.0 million head. (10) In 1970, total cattle slaughter was approximately 40 million head, but the fed cattle market totaled 25.6 million or approximately 64 percent of the total cattle slaughter. (11) In 1974, the fed cattle market totaled 23.5 million head or approximately 63 percent of the 36.8 million head of total cattle slaughter. (12) Total cattle slaughter in 1975 was over 46 million head. Fed cattle marketings in 1975 was approximately 21.2 million head or 46 percent of total cattle slaughter. (13)

As Figure 5 illustrates, U. S. cattle slaughter fluctuated during the period 1955 to 1975. Fed cattle marketings reached a peak in 1972, when 26.5 million head composed 70 percent of the total cattle slaughter of 38 million head. The decline in fed cattle marketings since 1972, was the direct result of a depressed national economy and cattle market. Cattle producers had 'geared up' their operations, prior to 1972, in anticipation of future market demand. The result was an oversupply of cattle when the 1973 economic depression occurred. (14)

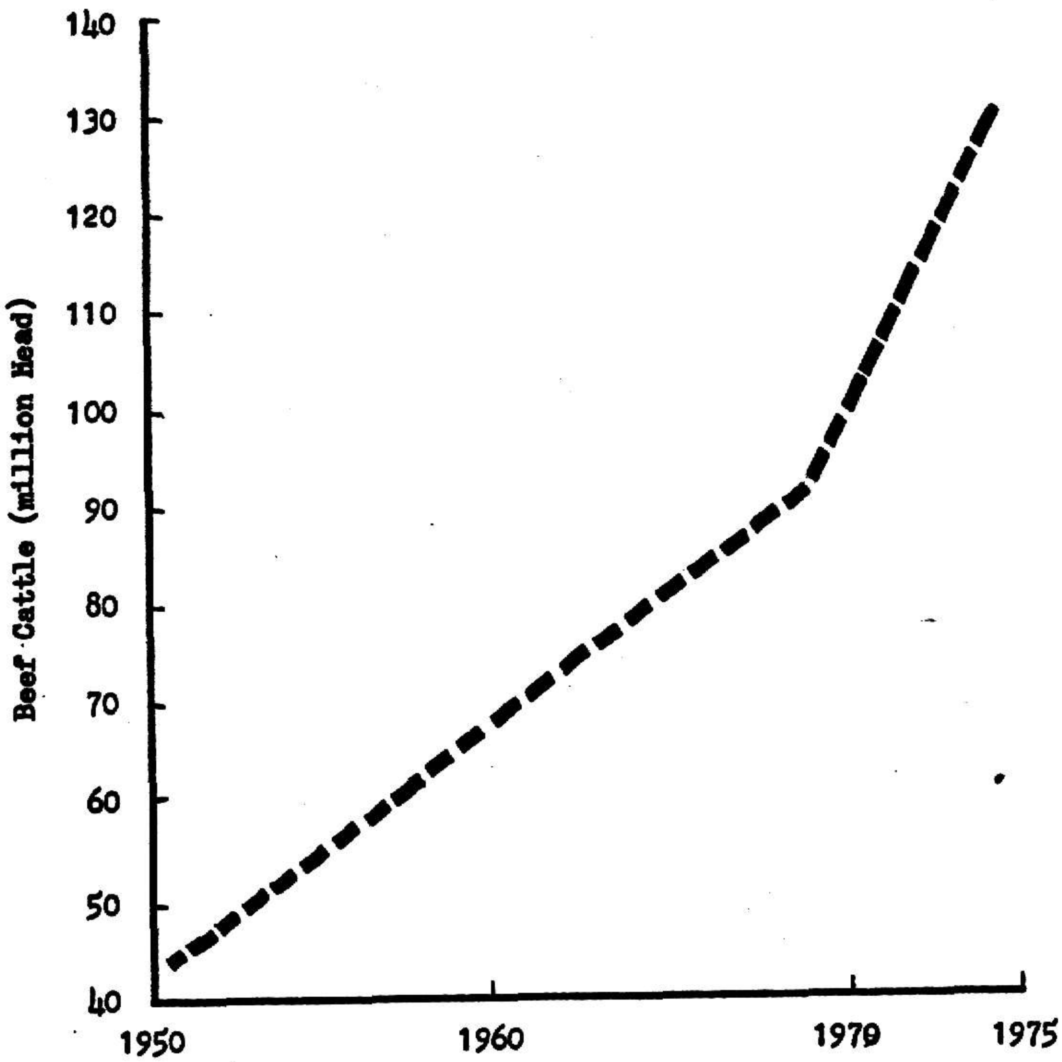


Figure 4. Beef Production in the United States

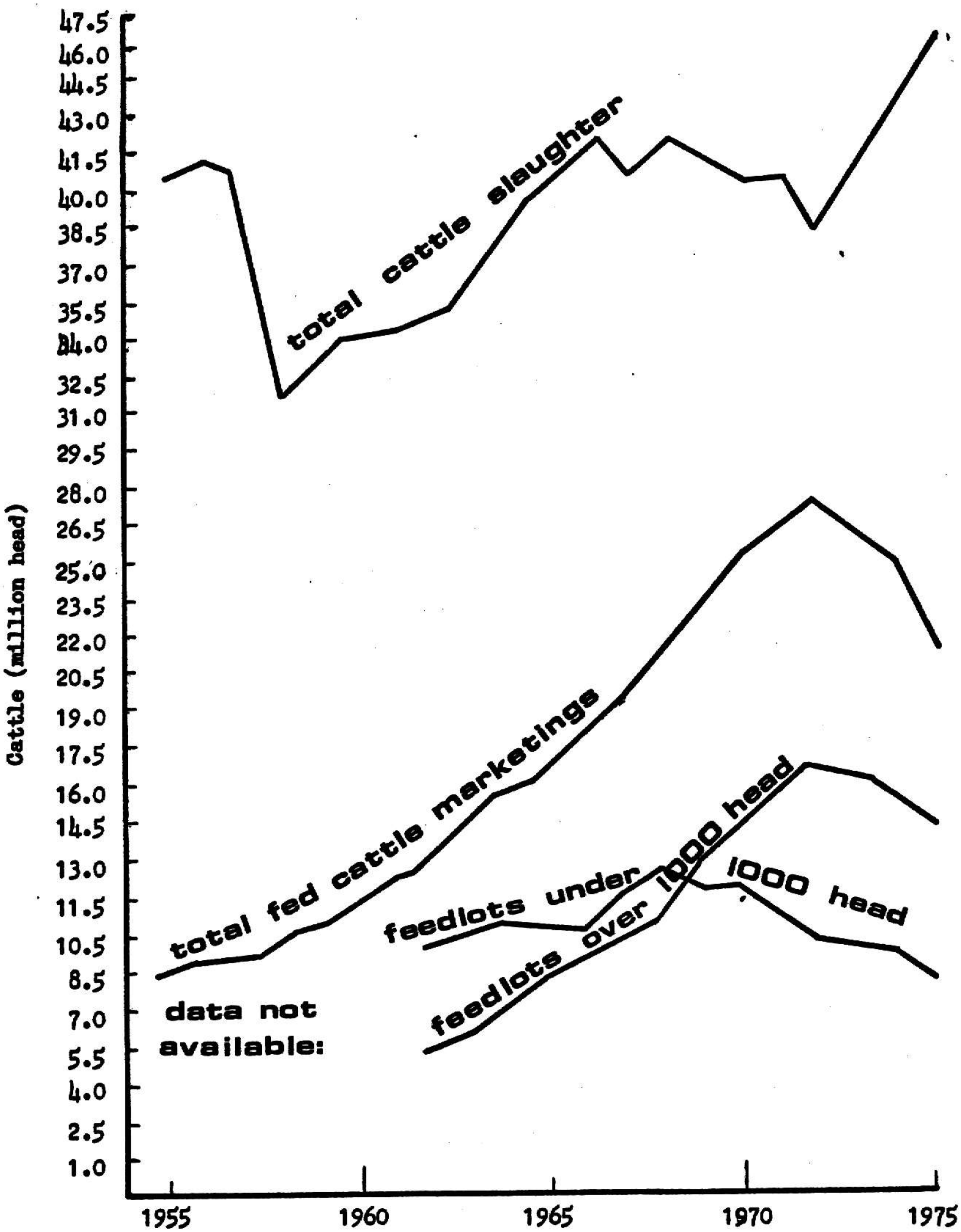


Figure 5. Trends in United States Cattle Marketings

Commercial Beef Cattle Feedlot Operation Production

Since the 1950's, the trend in finished beef production in the United States has been toward the development of the large commercial feedlot. Trends in fed cattle marketings from commercial feedlots, under and over 1,000 head capacity are shown in Figure 5. As Figure 5 indicates, fed cattle marketings from the larger commercial feedlots have been increasing since 1962, while fed cattle marketings from the smaller feedlots have been decreasing.

In 1962, according to Dyer & O'Mary (7), the number of commercial feedlots, under 1,000 head capacity, was 209,646 in the 23 major beef producing states. In 1967, the number had dropped to 209,505, but produced 11.8 million head of fed cattle for market, of the total 21.7 million head marketed. By 1970, these smaller feedlots had declined to 204,505. In 1975, commercial feedlots, under 1,000 head capacity, totaled 136,262 and produced 7.2 million head of fed cattle or 33 percent of the total fed cattle marketings of 21.2 million head. (13)

The number of commercial feedlots, over 1,000 head capacity, in the U. S. in 1970, totaled 2,242 but produced over 55 percent of the 25 million head of marketed fed cattle. (7) Commercial feedlots, over 1,000 head capacity, in 1974 numbered 1,922, and produced 15.1 million head or 64 percent of the total 23.5 million head of fed cattle marketed. In 1975, these feedlots numbered 1,764, and produced 13.2 million head of the total 21.2 million head or 62 percent of fed cattle marketings. (15)

In 1962, there were 5 feedlots in the United States with a capacity of 32,000 head or more. By 1970, the number had increased to 41, which produced 11 percent of all the cattle fed in the U. S. (7) In 1974, the number of these feedlots was 73, and produced 4.5 million head of the total 23.3 million head marketed, or roughly 20 percent of the total fed cattle marketings. (15)

In 1975, the number of commercial feedlots, over 32,000 head capacity, in the United States totaled 63, but produced 3.3 million head of fed cattle, or approximately 15 percent of the total fed cattle marketings. (13)

Although the number of commercial feedlots and fed cattle marketings in the United States have decreased since 1972, commercial feedlots presently are operating at near capacity, indicating that the number of fed cattle marketed will again increase when compared to total cattle slaughter, as the economic position of the Nation improves. (14) As the previously mentioned statistics indicate, the trend in the U. S. fed beef production is for the larger and more efficient commercial feedlot operations, over 1,000 head capacity.

Population Trends and Beef Production

At the end of the 19th century, per capita beef consumption in the U. S. was 72.4 lbs. (3) In 1970, the per capita beef consumption was 115 lbs., almost double the rate since World War II. (16) Beef consumption per person is expected to rise to over 130 lbs. by 1980, Figure 6. (17)

Population growth trends for the United States are shown in Figure 7. The population of the U. S. in 1970 was 205 million and is expected to increase to 232 million by 1980, with each person consuming approximately 130 lbs. of beef per year. (17) At present rates of population increase, commercial beef production will need to be increased by 174 million lbs. per year, approximately 280,000 finished cattle, to maintain present consumption levels. (7)

Another aspect of population trends that must be considered in beef production is the degree and direction of population shift or movement. In the U. S. today, the population is moving to the western, less densely populated states, from the more densely populated eastern and west coast states. Between 1960 and 1970, the 11 western states increased approximately 11 percent, while the remaining states increased 10 percent. This trend is expected to continue through the next decade. (7)

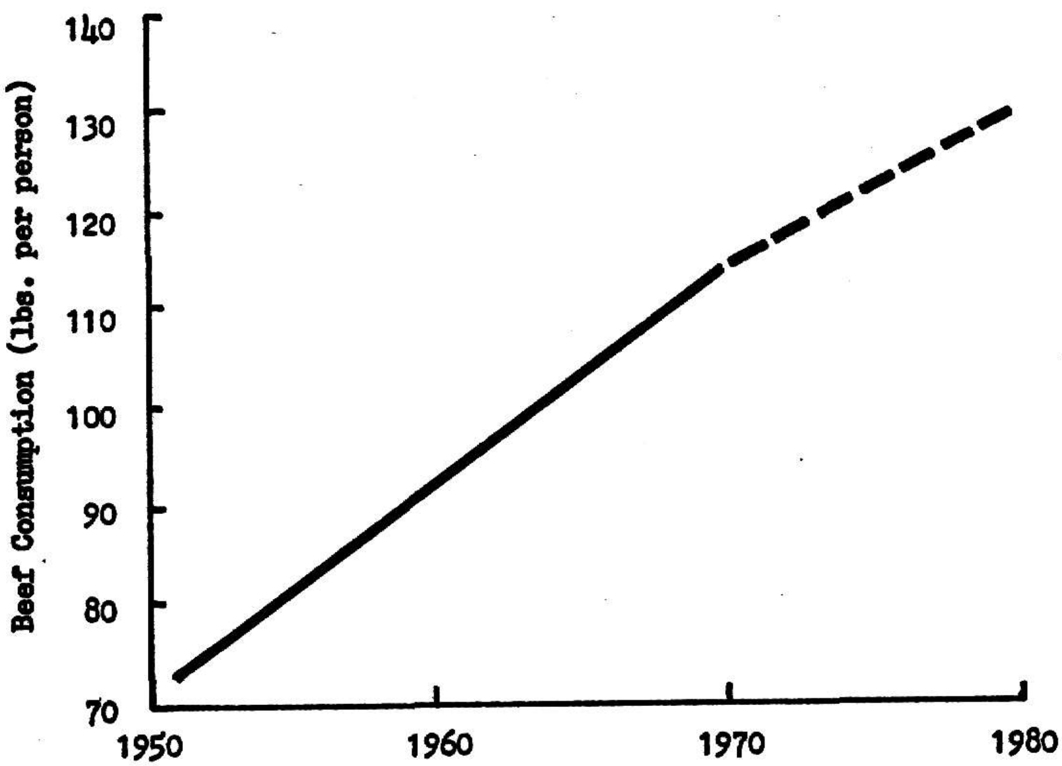


Figure 6. Beef Consumption in the United States.

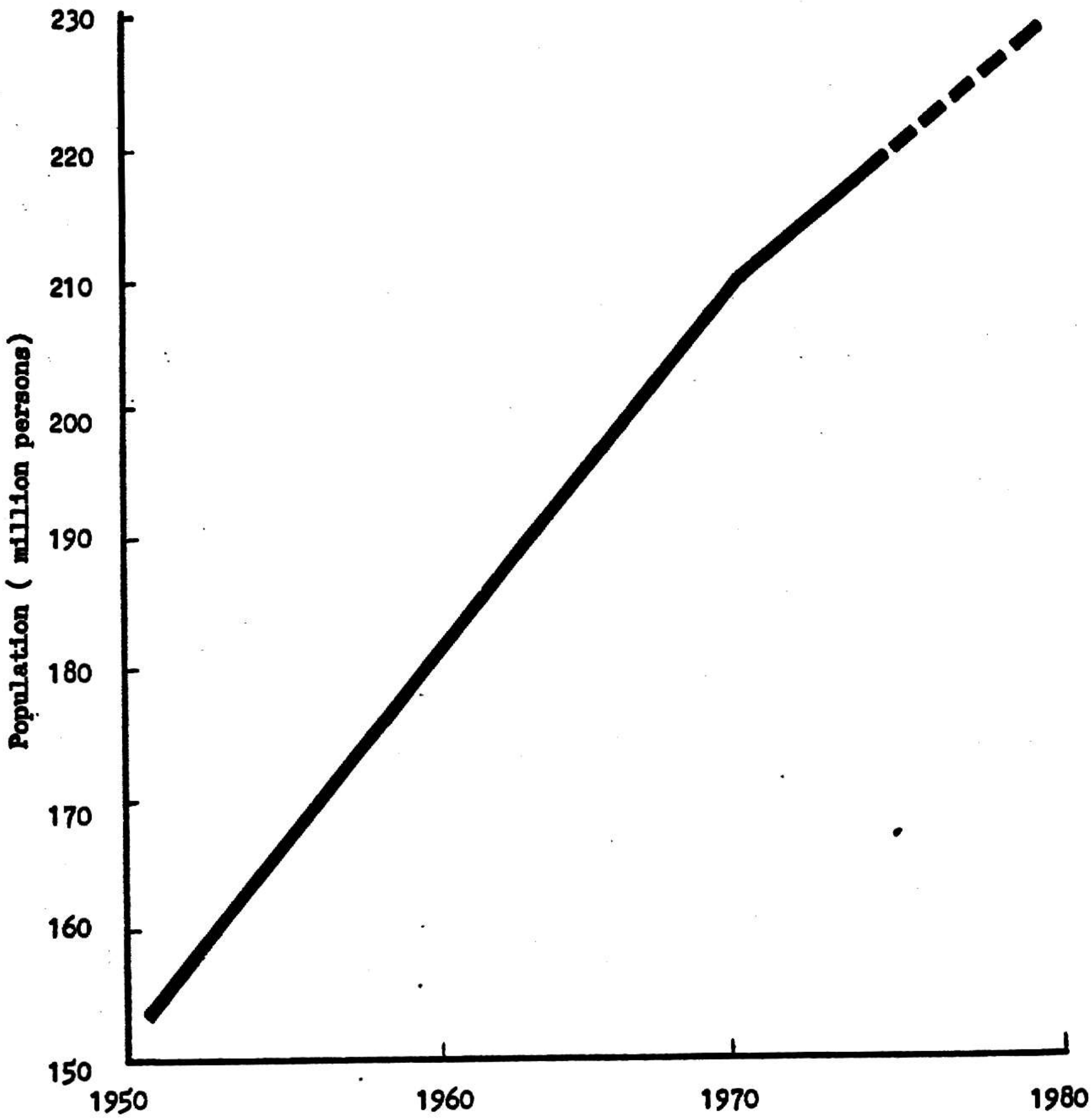


Figure 7. Population Growth in the United States

This shift in population will tend to reduce the amount of agricultural productive land, since population increases and agricultural production tend to use the same prime farm land. Approximately 2 million acres of agricultural land is converted to non-agricultural uses per year in the U. S. Therefore, it is almost mandatory that prime agricultural land be reserved to maintain agricultural production to meet future food demands. (7)

Consumption of Other Meats

The consumption of meats, other than beef, tends to reduce beef consumption to a degree, however, this consumption has little long term effect on beef intake, Figure 8. Pork consumption per capita, decreased 18 percent in the years 1944 to 1970, while poultry consumption increased 50 percent in the years 1960 to 1970. Simulated meats, according to Dyer & O'Mary (7), will not compete successfully with pure beef products until improvements in taste and appearance are made. Since soybeans and cornflakes do not taste like prime rib, beef will continue to be the favorite meat and protein source of the American consumer. Presently, about 2.5 percent of the average American's annual income goes to buy meat or meat products. (8)

Future Trends

The cattle feeding industry, due to recent economic setbacks, is in a period of instability. However, commercial feedlots will remain the major source of finished beef cattle production. (18) With the smaller feeders going out of business, the market will become more stable, and the larger feedlots will have to feed cattle no matter what the market, to make their investments pay. (19)

The cattle feeding industry, according to Prof. McCoy (14), is expected to remain stable in the number and size of the larger feedlots in future years. The rapid expansion of the past 10 to 15 years is not expected to

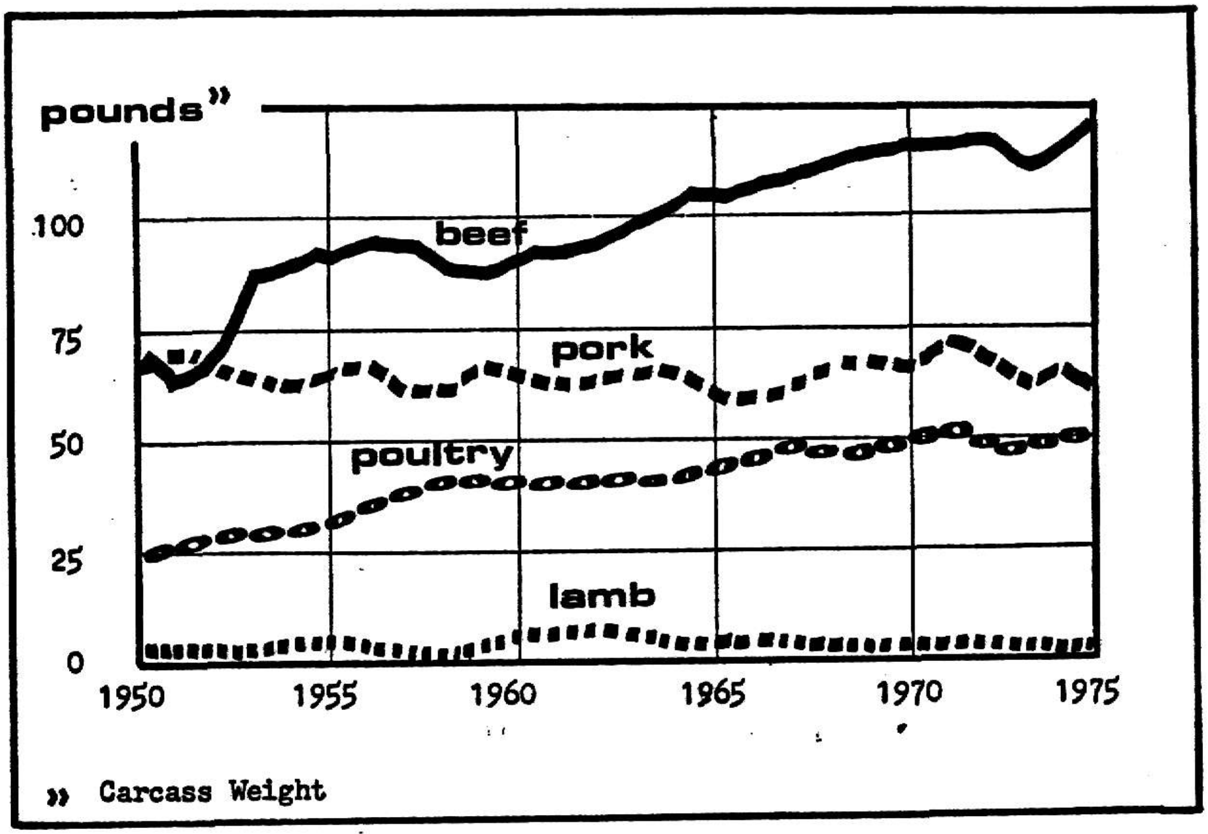


Figure 8. Meat Consumption Per Person in the United States

continue. Rather, a slower expansion of the larger capacity feedlots, over 30,000 head capacity, will be the trend. Beef cattle will continue to be fed in the 'Beef Belt", as well as in the "Corn Belt' and Southwest areas. A geographical shift in the areas of finished, beef cattle production is not expected. (14)

Many practices concerned with feedlot operation will be subject to change in the future. A greater shift to computerized management of operations will occur. More mechanization of feedlot operations will also occur, as technology advances in feed preparation, marketing and milling equipment. (7)

Commercial feedlot operations will no doubt, become subject to additional environmental regulations and restrictions at all levels of government, as the size and number of the large scale operations increase. However, according to Earl Butz (20), United States Secretary of Agriculture, America is a red meat consuming Nation, and is going to stay that way.

CHAPTER 5

ENVIRONMENTAL REGULATIONS OF THE COMMERCIAL FEEDLOT INDUSTRY

In the early development of the beef cattle feedlot industry, during the 1950's and 1960's, expansion was rapid, with little or no consideration given to environmental planning or pollution control facilities. Since manure is not the profit end of the beef cattle feedlot industry, it was only natural for feedlot owners to minimize operating costs in waste manure handling. Due to the high degree of competitiveness and narrow profit margins of the industry, the feedlot owners were reluctant to construct pollution control facilities. Since 1968, the situation has changed as commercial feedlots must comply with county, state and federal environmental pollution control regulations or cease to operate.

Sources of Environmental Regulations

Environmental pollution control regulations on the commercial feedlot industry are imposed by agencies outside of the feedlot industry, although the industry does take an active interest in the formulation of the regulations. Regulations on the feedlot industry come from three primary sources; the county, the state and the federal government.

County

County or local regulations are usually of the land use or zoning ordinance nature. Commercial feedlots are considered an agricultural industry, and must be located in areas that are zoned for agricultural purposes, within the governing county. Some counties have established limits on the distances that feedlot operations must be from municipalities, residential dwellings, recreation areas, arterial highways, water bodies and etc. Since uniformity is not governed, each county may establish its own regulations.

State

Individual states have the right to establish regulations for commercial feedlot operations. Regulations will vary from state to state, but usually require that the feedlot apply for an operating permit, which is the legal right to operate within that state, providing the feedlot operates within the limits of pollution control regulations.

In the late 1950's, prior to environmental regulations, several large capacity feedlots were constructed in central Kansas. Manure management procedures were not well designed and the normal summer rainfalls caused considerable runoff to enter streams, resulting in fish kills and polluted waters. This experience promoted Kansas to pass the first feedlot licensing laws within the United States. The State of Kansas, thereafter, required that State approved water pollution control facilities be incorporated into feedlot design. The law was passed by the State Legislature in mid 1967 and became effective on January 1, 1968. (7)

The Kansas feedlot ordinance requires that a feedlot with a capacity of 300 head of cattle or more, must have a state permit to operate and have an approved waste collection sump or detention structure capable of retaining 3 inches of runoff from the feedlot within a 24 hour period, if runoff enters water courses of the United States. (21) The ordinance also requires that the sump or detention structure shall be emptied and the waste runoff disposed of in approved or recommended manner, to allow the detention structure to hold maximum runoff again, within one weeks time. It is possible, however, for a feedlot to obtain an operations permit without runoff detention structures, if runoff from the feedlot does not enter waters of the U. S. and is not considered as contributing to pollution problems. (21)

The Kansas feedlot ordinance, being the first of its kind, was used as the model law by other states as they passed similiar legislation for feedlot operations. Presently, all of the major beef producing states have water pollution control regulations for feedlot operations.

Federal

In addition to county and state laws, the federal government, via the Environmental Protection Agency, has established runoff pollution control regulations for commercial feedlot operations. The EPA regulations state that if a feedlot, regardless of capacity, is considered a point source of pollution, it must obtain a National Discharge Elimination Systems permit to operate within the United States. A feedlot is considered a point source of pollution if:

1) wastes are discharged directly into a full or part-time stream that cuts across or closely parallels the feedlot

2) a man-made ditch, pipe or flushing system empties feedlot waste into a stream or water body

3) it is determined that the feedlot is a significant source of water pollution

The NDES permit is the legal right to operate a feedlot and discharge runoff into U. S. waters only if runoff exceeds the limit established for a 25 year, 24 hour storm event. If this limit is exceeded only once in 25 years, a discharge permit is not required. (22)

Doctrine of Nuisance

Almost all of the environmental pollution control regulations with which commercial feedlots must comply, have to deal with the control of waste water runoff. While air quality standards for livestock operations do not presently exist in most states, they most likely will be adopted in the near future. (23) It is possible that air quality standards could become mandatory for the feedlot industry, as some industries already have such regulations.

The most common compliant, relative to commercial feedlot operations, at present, is that of air pollution. (24) Persons living near a commercial feedlot are protected under the law by the concept of nuisance. A nuisance, in the legal sense, may be summarized as anything which causes an unreasonable interference with the use and enjoyment of property. The various aspects of nuisances, relative to livestock production, were analyzed by Paulsen. (25)

The ownership of land includes the right to impregnate the air with odors, dust, smoke and noise. It also includes the right to pollute the water, provided these actions do not substantially interfere with the comfort of others or injure the use and enjoyment of their property. Whenever land is used in such a way to violate this principle, the owner may be guilty of maintaining a nuisance. The doctrine of nuisance acts as a restriction on the right of an owner to use his property as he please. However, what constitutes a nuisance in a particular case must be decided upon by the facts and circumstances of that instance. (24)

A nuisance may be either public or private. If a number of persons are involved, it is considered public. If only one or several persons are involved, it is considered to be private. A person who suffers damage or feels he suffers damage due to the odor and noise of livestock operations, has two courses of action open to him; 1) a suit for damages, or 2) a suit to enjoin or abate the nuisance, either or both. The remedies of injunction or abatement are generally considered as being harsh by the courts. Normally, only the part of the operation which amounts to a nuisance will be abated or enjoined. For the odor or noise from a livestock feeding operation to be considered a nuisance, it must be offensive to the senses and materially interfere with the comfortable enjoyment of property within the area. (24) Therefore, to keep nuisance suits at a minimum, commercial feedlot operations should incorporate management practices and site planning considerations that will effectively control nuisance problems.

In the case of injunction, the plaintiff can seek relief of 'actual' or 'punitive' damages. Actual damages means that the plaintiff is seeking to recover his damages, expenses, and property losses caused by the defendant's actions. Punitive damages are granted if the defendant's conduct intentionally injured the plaintiff and are imposed in the form of a fine. (25)

Another important factor in legal matters, is whether the feedlot is considered a temporary or permanent nuisance. This determination, made by the court, may influence the feedlot's future action. A temporary nuisance is one which can be corrected if the feedlot initiates certain changes in design or management practices to make the operation less offensive to neighbors. (26)

A feedlot, sued for temporary nuisance, is liable only for damages suffered by the defendant in the past. However, if the feedlot does not take corrective steps, it can be sued again, to recover damages since the last court action. Thus, if nuisances are not corrected, the feedlot may be subject to periodic lawsuits. (26)

A permanent nuisance is one which cannot be corrected. Therefore, the plaintiff can seek court action to obtain past and future damages in the same legal action. If a feedlot has been termed a permanent nuisance, there may be less incentive to change operational procedures to decrease pollution problems. However, the cost of maintaining a temporary or permanent nuisance should be weighed against corrective development costs. (26)

Asethetic Quality

Although regulations on appearance are not mandatory for feedlot operations, the volunteer application of a 'good appearance' can help in keeping nuisance suits at a minimum. According to Wendling (27), the Kansas State Board of Health recently received numerous complaints about odor from a municipal waste disposal lagoon near a small Kansas community. Upon inspection, the state officials could not find any operational defect in the lagoon system. However, they did suggest to the owner that a 'general appearance clean-up' of the facility could perhaps minimize the situation. Fences were painted, the grass mowed, junk cleared away and some shrub landscaping installed. Thereafter, the number of complaints diminished significantly. There appears to be a relationship between appearance and the thought of odor, as this case points out.

Ron Miner, an agricultural engineer from Oregon State University, emphasizes this concept of odor and appearance by stating that: 'odors are closely tied to vision'. (28) According to Miner (28), if a feedlot operation looks dirty, people will detect odors much faster than when confronted with a clean, neat appearing facility. Miner also mentioned that: 'if a viewer cannot see the odor causing problem, he will not as readily smell it'. Miner's advise to feedlot operations is to: 'maintain a neat and clean site appearance, control runoff, build in areas where the prevailing winds will carry odors away from urban areas and make it look like it smells good'. (28)

In a 1973 research project conducted by Robert S. Kerr, Environmental Research Laboratory, Ada, Oklahoma (29), the commercial beef cattle feedlot's position on environmental quality was assessed as:

In recent years, there has been a successful advance of programs for 'national beautification'. In short, these programs require the use of privacy fences to conceal such unsightly places as junk yards, dumps, freight yards and salvage yards from public view. In the foreseeable future, unsightliness and noise emission from livestock feeding operations, may bring about public-initiated court actions. The selection of a site with vegetative shelter belts and/or land formations suitable for visual concealment purposes or one located a sufficient distance from highways, may pervent problems which do not yet exist.

As indicated in the previous chapters, the commercial beef cattle feedlot industry will continue to be a permanent feature on the American landscape in future years. To minimize environmental impact, careful site planning is needed to maintain a harmonious relationship between this industry and the surrounding environment.

CHAPTER 6

SITE SELECTION CRITERIA FOR COMMERCIAL BEEF CATTLE FEEDLOT OPERATIONS

In the early stages of development, the commercial feedlot industry gave little consideration to site selection criteria and environmental quality planning. The results were; feedlots built too close to urban areas, causing nuisance problems: polluted water courses and manure disposal problems. As environmental regulations were enacted, the feedlot industry has had to abandon previously recommended practices, and implement new site selection and design criteria.

In late 1971, the President's Water Pollution Control Advisory Board undertook a study to review water pollution problems caused by animal wastes. In January, the Board's report was presented with the following remarks relating to feedlot site selection: (30)

> Particularly vexing water pollution problems were observed by the Board, which were related to specific sites used for animal production. Many of the difficulties could be minimized, if proper site selection criteria, including climatologic and geologic conditions were developed for implementation by the animal production industry. Additional waste management demands are created by urban encroachment into agricultural production areas.

The President*s Water Pollution Advisory Board recommended that: (30)

> Attention be given to the development of national and/or state site selection guidelines, which will determine the best land areas to be used for animal production to minimize water pollution.

In response to this report, research was undertaken to establish site selection guidelines for commercial feedlots. Among the researchers was the Cooperative Extension Service of the Great Plains States which published a fact sheet in December 1973 entitled 'Locating a New Feedlot'. (23) The Environmental Protection Agency, in 1973, sponsored an extensive research project conducted by the Kerr Environmental Research Laboratory, Ada, Oklahoma, which also established comprehensive guidelines and recommendations on feedlot site selection. (29)

Both of these publications are excellent sources for feedlot site selection guidelines. It is unpractical, at this time, to duplicate their research. For purposes of this study, a brief review of the factors influencing feedlot site selection, is in order, as these factors can directly affect site planning decisions.

Major Factors in Site Selection

The selection of the site for a commercial beef cattle feedlot involves the careful consideration of many factors. The success of the feedlot operation is directly related to the amount of consideration given to each of these factors.

The major factors influencing feedlot site selection are; geographic features of climate, topography and drainage, prevailing winds and soil conditions. According to Dyer & O'Mary (7), feed sources, cattle sources, markets, transportation routes and the availability of power, water and gas utilities are also important considerations.

Squire and Creek (6), indicate that the location of a commercial feedlot is also dependent on: 1) planning of an adequate scale of operation. 2) secure an exclusive tenure of suitable land. 3) adequate management for the setting up and operation of the project. 4) long-term capital for fixed improvements such as roads, land forming and utilities. 5) medium term capital for machinery and equipment and 6) short-term capital for feeds and operating expenses necessary to finance to the break-even point.

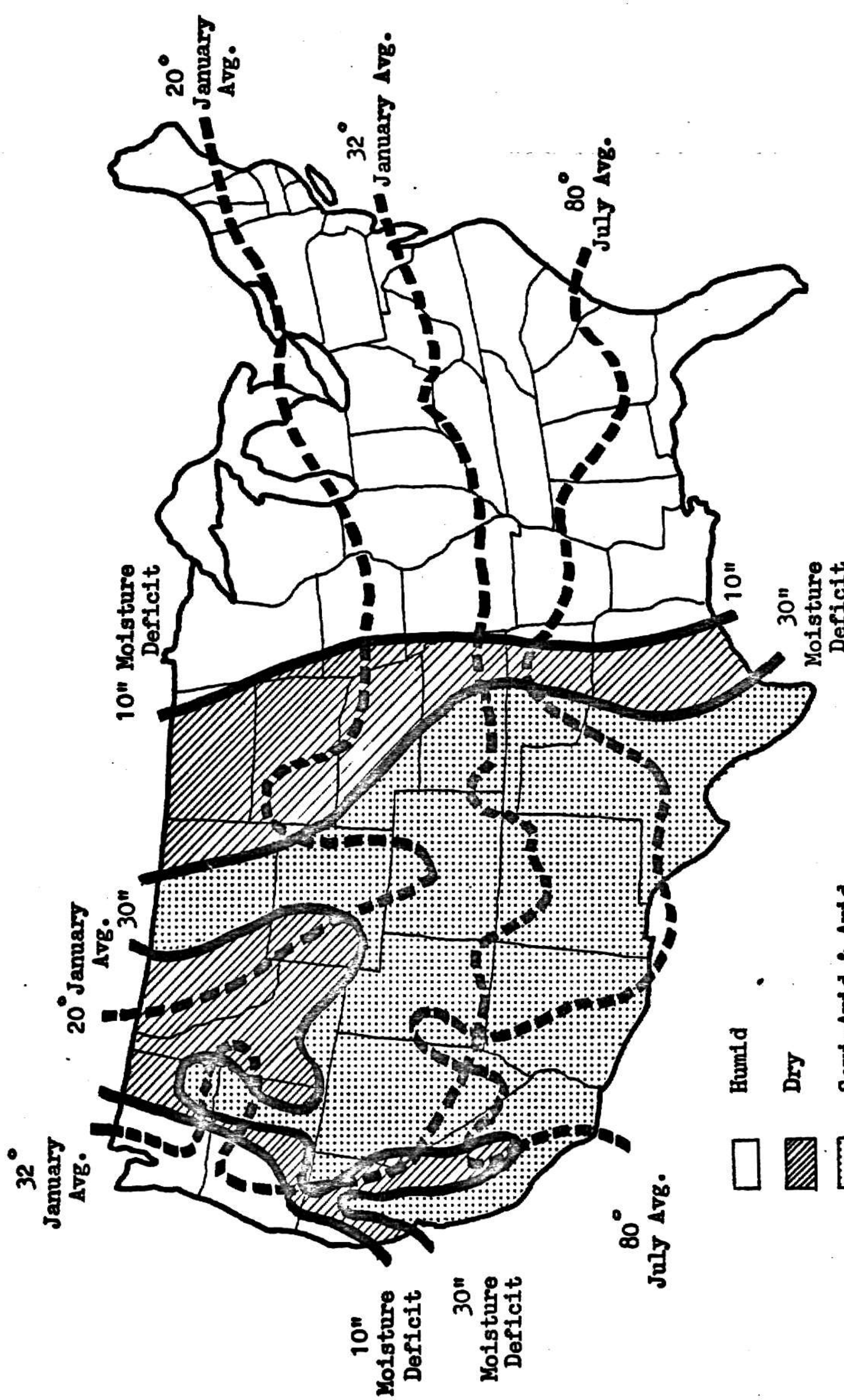
Climate

Commercial feedlot operations are mainly outdoor, open-air operations, and subject to all climatic conditions. There is a trend, in some areas of the United States, toward total confinement feeding operations which have completely enclosed the feeding pens from the climatic elements. Although this study is not directed at this trend, Shuyler and Associate (29) provide extensive coverage.

Bond and Associates (31) have shown that the effects of mud, rain, snow, temperature and wind can increase the feed requirements of beef cattle by as much as 33 percent, as the cattle must increase their body metabolism rate to offset severe climatic conditions. Therefore, the location of a feedlot must be selected where these climatic conditions are minimal.

According to Bond (31), the average July temperature of 80 degrees F. appears to be the maximum for optimum beef production. Daily weight gains are reduced in most breeds when the air temperature exceeds 80 degrees F. The average January minimum temperature, for optimum beef production, appears to be 20 degrees F. To keep waste manure management systems working properly, the average January temperature should be above 32 degrees F. as much as possible to prevent freezing conditions, Figure 9.

Rainfall and water evaporation rates must also be considered in feedlot site selection. Shuyler and Associates (29) have determined that the 30 inch moisture deficit area is the most advantageous for evaporation of liquids from waste runoff detention ponds. In areas of less than a 10 inch moisture deficit, the required area for evaporation increases rapidly, as it becomes more difficult to reduce large volumes of runoff, Figure 9.



Climates of the United States which affect Finished Beef Production

Figure 9

Figure 10 shows the normal monthly precipitation rates for the United States. Precipitation rates, for the major, finished beef producing areas in the Nation, are less than 16 inches per year. Low precipitation rates are desired to maintain dry pen conditions.

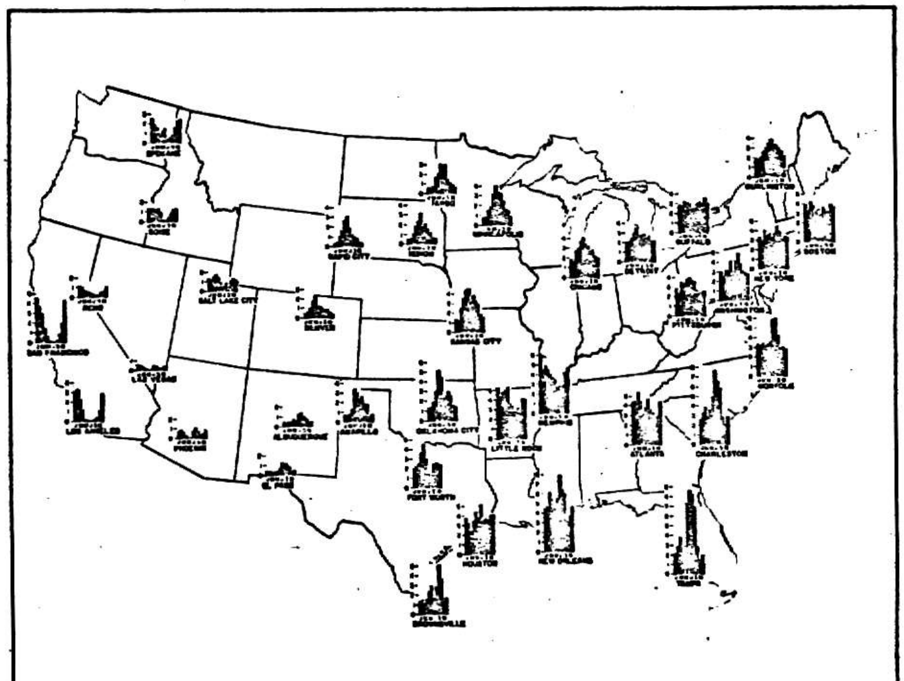


Figure 10. Normal Monthly Precipitation Rates for the United States, in inches (1931-1960)

Topography and Drainage

The most important geological feature in feedlot site selection, next to climate, is topography and drainage. The favored topography for feedlot sites are gentle slopes of 3 to 6 per cent gradient, to the south and east, away from prevailing winter winds, Figure 11.

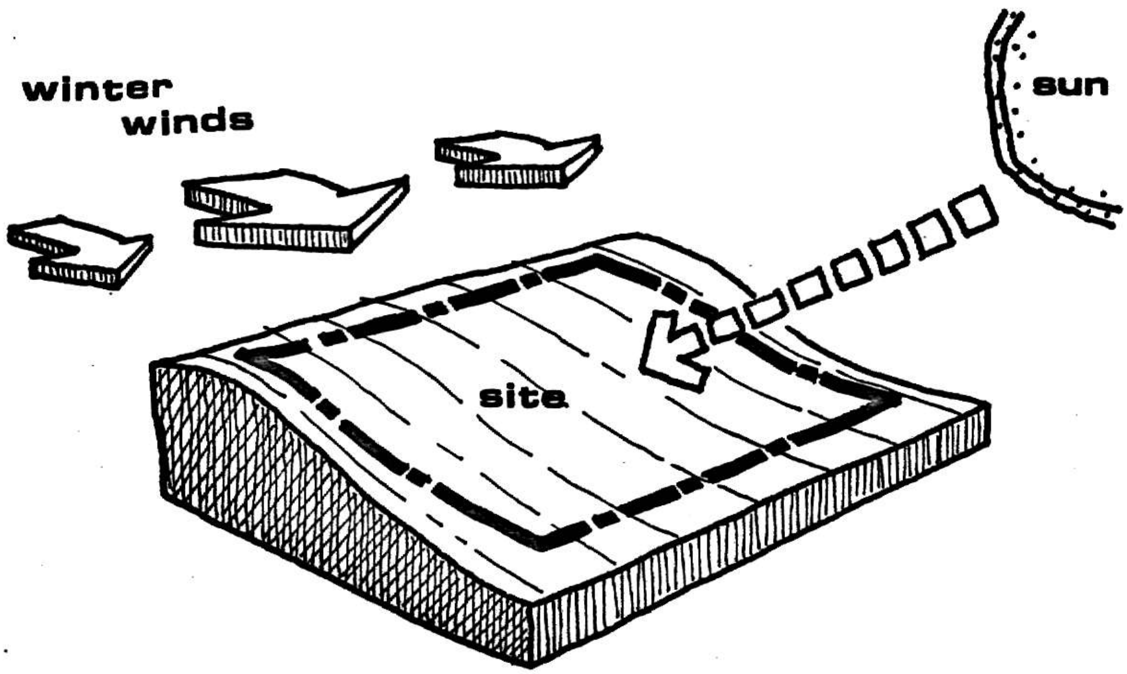


Figure 11. Favored Topography for Commercial Feedlots

Surface slppes of 3 to 6 per cent are desired to provide adequate drainage of runoff, for dry pen conditions. Slopes in excess of 10 per cent, can result in erosion problems. (32) Slopes to the south and east are favorable, not ònly in the control of prevailing winter winds, butiin the fact that solar radiation helps to warm the pens in winter months and dry pen areas faster, than on northern or western slopes. (23) Construction costs on gentle slopes are less than on hilly areas, makiòg gentle slopes also economically favorable. (7)

The topography of the land parcel should be of sufficient size to accommodate the spatial requirements of the commercial feedlot operation. Approximately 7 to 10 acres per 1,000 head of capacity are required to accommodate the total feedlot operation which includes pens, feed storage, feed mills, administration, animal handling facilities, feed and drive alleys, equipment storage, solid waste storage and liquid runoff detention areas. (23) A 10,000 head capacity feedlot will require approximately 100 acres of land for the physical site. In addition to the 100 acres, it is recommended that 1½ to 2 times the area of the physical site, or 200 acres, directly adjacent to the feedlot site, be acquired for liquid runoff disposal. Solid waste manure disposal requires an additional 1 acre per 5 head capacity. (23) Direct ownership, by the feedlot, of the liquid runoff disposal area is desired to eliminate disposal problems. However, direct ownership of the solid waste disposal area may or may not be desired, depending upon economic conditions. It is desirable, although, to locate the feedlot site in an area where abundant cropland is available to serve the total feedlot operation and to provide a 'buffer zone' to encroachment, Figure 12.

In addition to cropland requirements for solid and liquid manure disposal, the topography of the area surrounding the feedlot site should be considered to prevent prevailing wind conditions from utilizing land forms that could funnel feedlot odors and dust into populated areas, Figure 13. (29)

An area of most concern in selecting topography for a feedlot is that of water pollution. To prevent the pollution of surface water bodies, the feedlot site should be located as far away as possible from surface water streams and lakes. According to the <u>Great Plains Beef Cattle Feeding Handbook</u> (23), it is impossible to suggest a specific distance, since lot size,

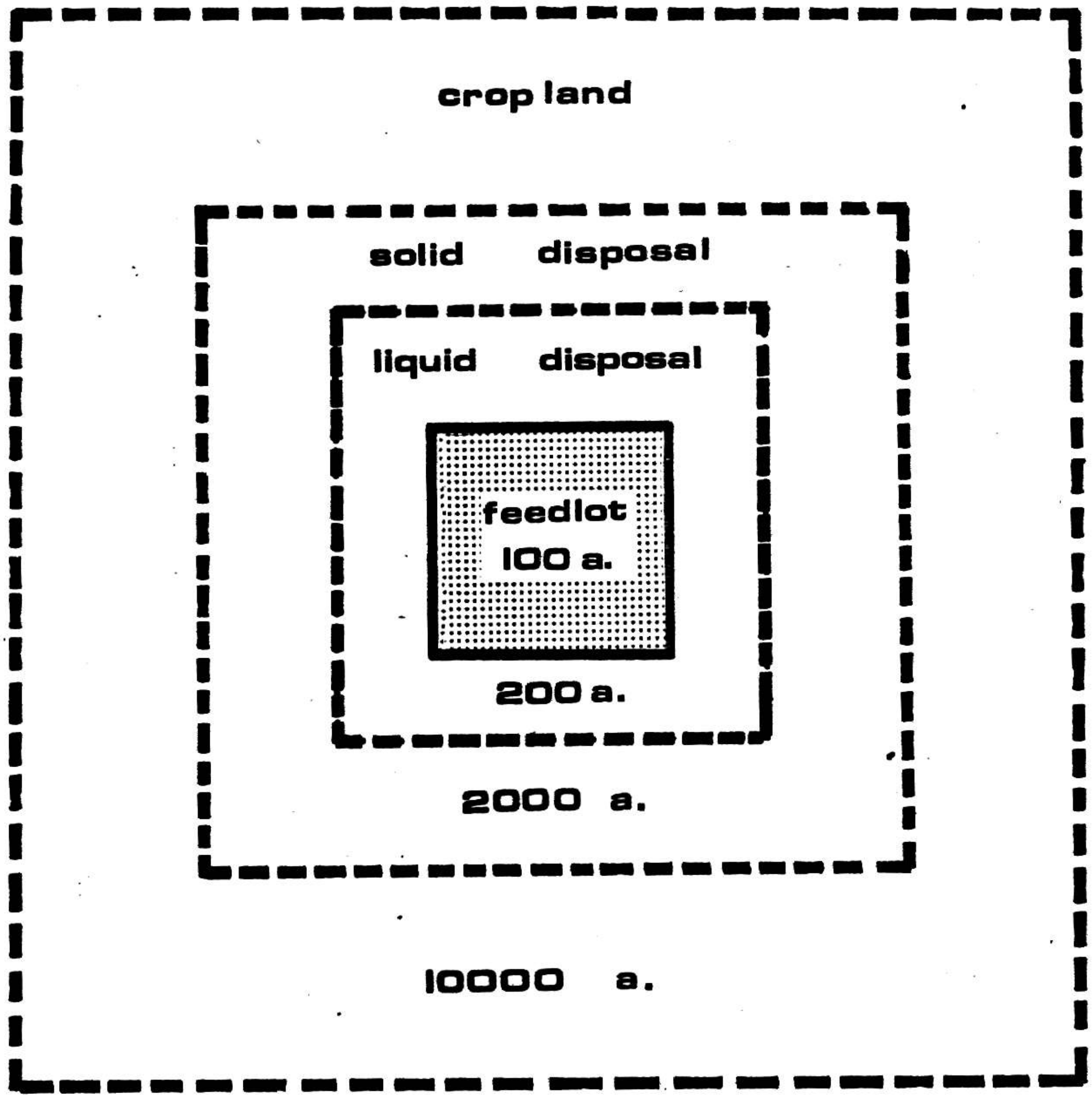


Figure 12. Spatial Requirements (acres) for 10,000 Head Capacity Feedlot. Surrounding area serves as 'buffer zone' to encroachment.

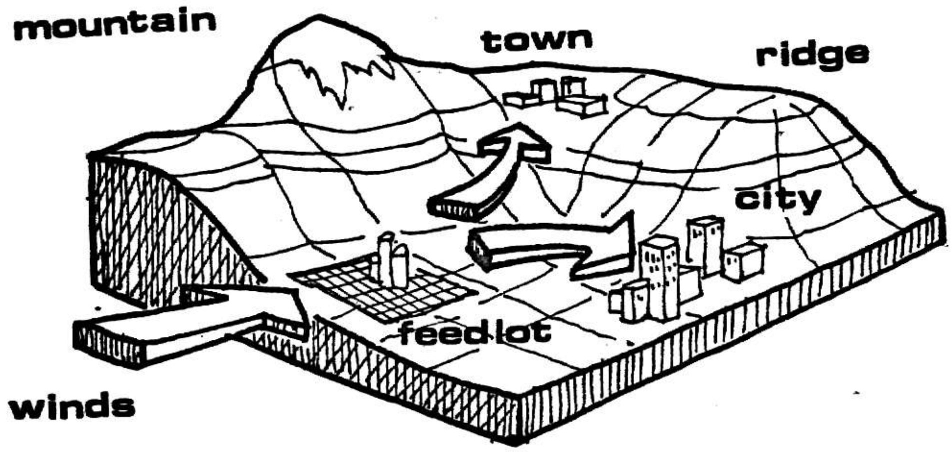


Figure 13. Unfavorable Topography for Commercial Feedlot Operation. Terrain funnels odor and dust into urban areas.

topography, soil and climatic conditions will vary from location to location. However, Shuyler and Associates (29) point out that several states have placed restrictions on the minimum distance that a feedlot can be located from surface water, residential dwellings, municipalities, recreation areas and arterial highways, but does not indicate the restriction distance.

The Missouri River Basin Animal Waste Management Pilot (Steering) Task Group (33) suggests that feedlots should not be located closer than one-quarter of a mile from a surface water course. This distance should allow for ample space for the construction of liquid runoff detention structures.

The Minnesota regulations for the control of wastes from livestock feedlots specify that new livestock feedlots are prohibited within: (33)

(a) shorelands, floodways and sinkholes

(b) 1,000 feet of the boundary of a public park

(c) one-half mile of the nearest point to a concentration of ten or more private residences at the time of construction.

The Iowa regulations for the control of water pollution from livestock confinement facilities state that: (33)

> if the feedlot contributes to a watercourse draining more than 3,200 acres of land above the lot and the distance to the nearest point on the affected watercourse is less than 2 feet per head of cattle in the feedlot, pollution control facilities must be incorporated in the feedlot design.

As these regulations indicate, the distance restrictions on feedlot location will vary from region to region and should be considered when selecting topography and sites for commercial feedlot operations.

Prevailing Winds

Extensive research on prevailing winds in feedlot site selection has been conducted by Prof. John M. Sweeten, Texas A & M University. He indicates that the confined feeding of cattle in feedlots inevitably leads to odor production from solid and liquid waste manure. Although waste manure management practices can reduce odor levels, these measures are not completely effective. (34) Therefore, feedlots should be locate as far away as possible from populated areas, in the direction of the least probability of prevailing wind occurence.

According to Erickson and Phar (35), the feedlot should be located at least 5 miles from urban centers and populated areas, to prevent air pollution problems and nuisances. Odors from feedlots can travel 8 to 10 miles, depending upon atomspheric and wind conditions, as pointed out by Olsen (23).

More odor is produced in feedlots during warm, moist times than during cool conditions because of increased anerobic action in manure. Since warm, moist conditions occur more frequently in the spring and summer months, feedlot sites should be selected that are north, east or west of populated areas, Figure 14. (23)

Accprding to Sweeten (36), average monthly and annual wind speeds should be considered, along with wind frequency direction. A surface wind rose diagram, Figure 15, for the United States, indicates the percentage of time that the wind blows from the 16 different compass points. The longer the spike in a given direction, the greater the probability of receiving wind from that direction.

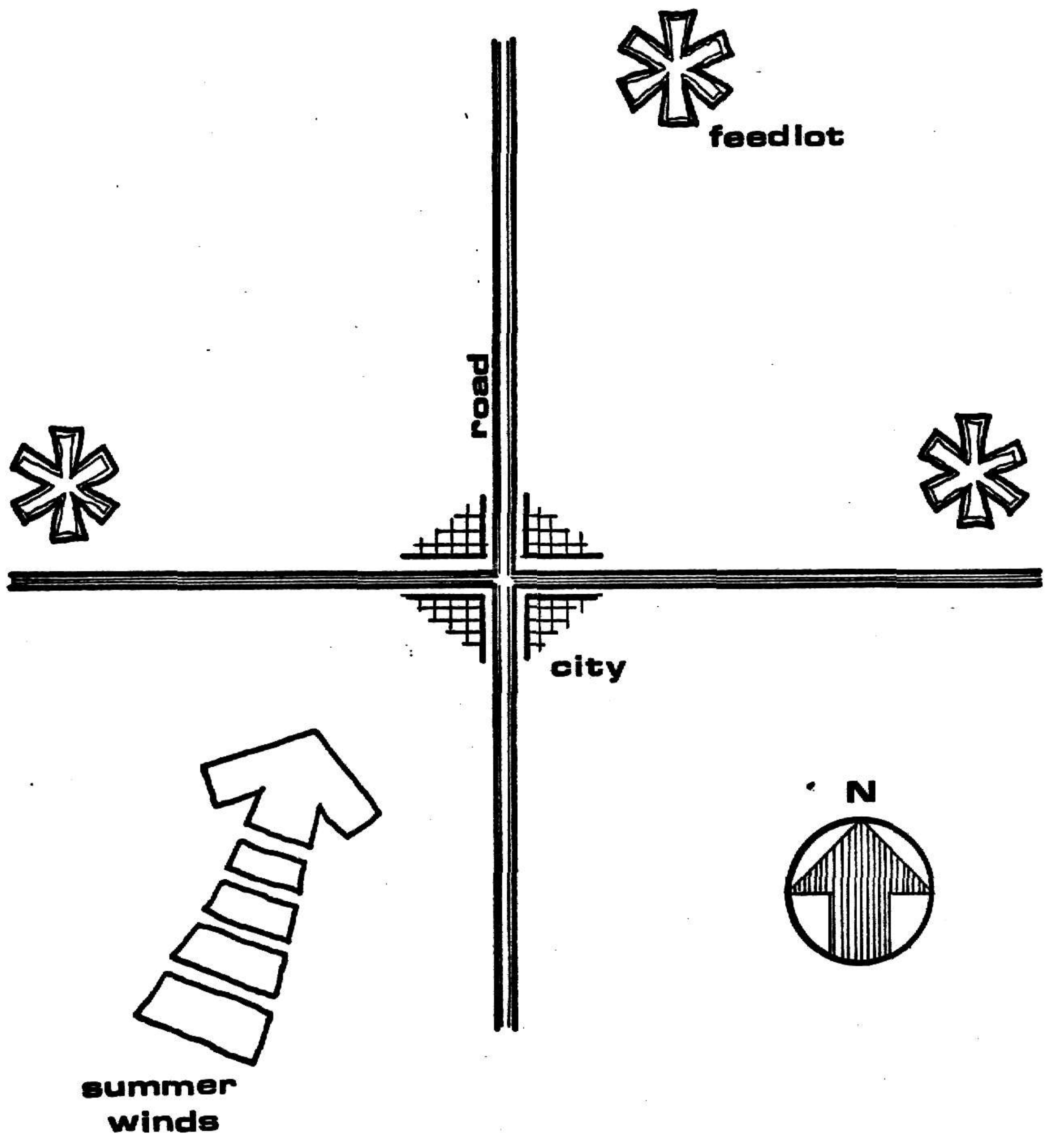
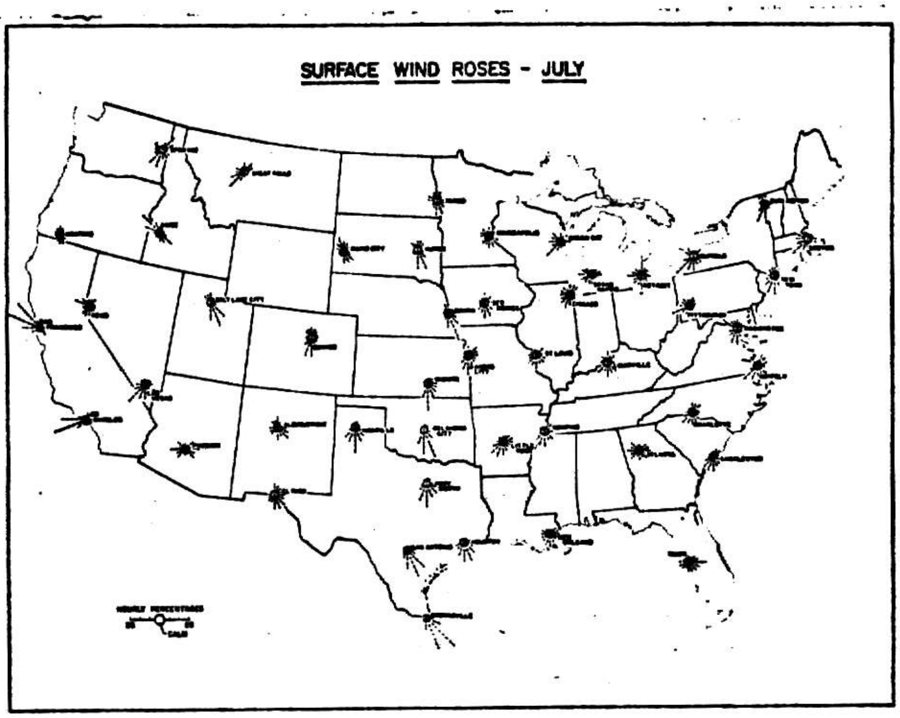
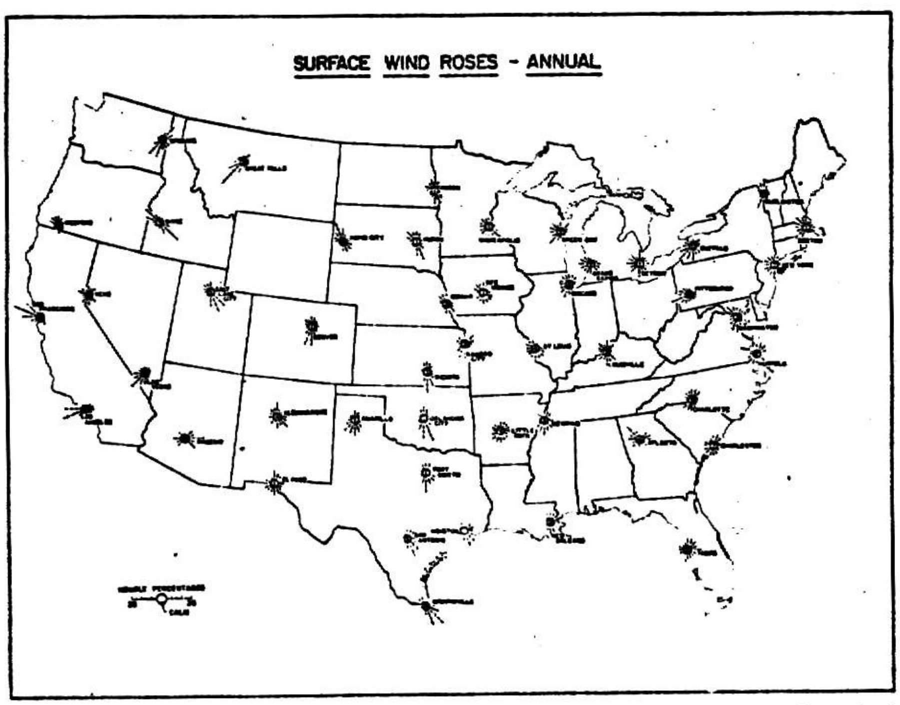


Figure 14. Suggested location for feedlots in relation to urban areas.



Surface wind roses showing the percent of time the wind blows from each of the 16 compass points in July. A long spike toward the center means a high probability of wind from the direction indicated.



Surface annual wind roses showing the percent of time the wind blows from each of the 16 compass points.

Figure 15. Surface wind rose diagrams for the United States.

Odor concentration downwind from a feedlot facility will vary in inverse proportion to wind speed. If the wind speed doubles, the odor concentration will be reduced by one-half, due to a greater spacing of odor molecules in the air stream. Sweeten (36) indicates that the climatic conditions of the Great Plains region are favorable for the dispersion of odors, since this region experiences greater wind speeds thru out the turbulent mixing layer, 0 to 6,000 ft. altitude, of atomsphere. However, wind speed factors are less important in feedlot site selection than wind direction considerations. (34)

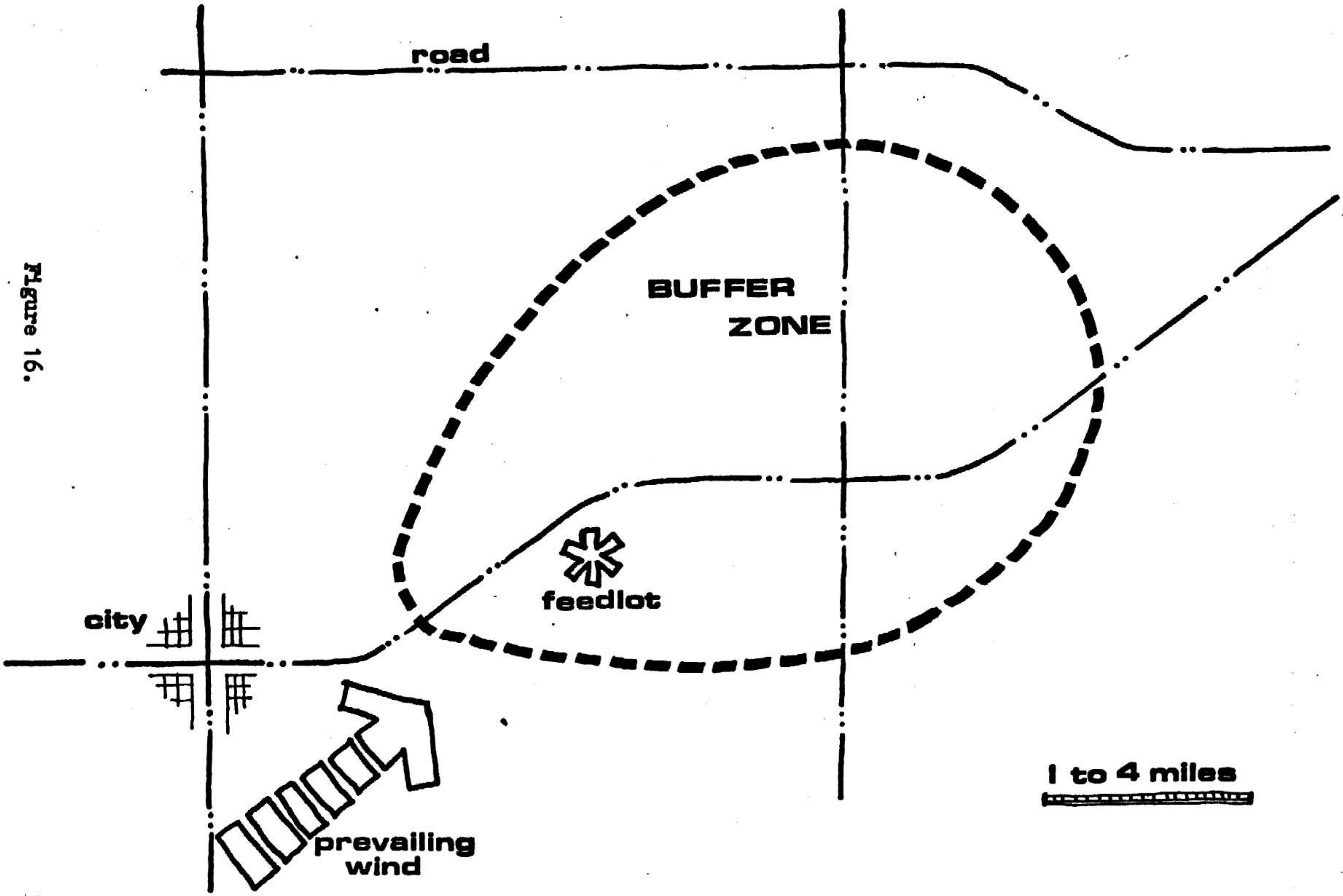
To allow odors and dust, from feedlot operations, to dissipate before reaching populated areas, an egg-shaped buffer strip of land, with the feedlot located at the small end, should be located down-wind from the feeding facility, Figure 16. The size of this buffer strip is dependent upon the feedlot size, capacity and waste manure management practices. (34) Shuyler and Associates (29) recommend that this buffer strip be from 4 to 20 miles in length, along the center axis, and oriented according to prevailing wind direction.

Soils and Geologic Structure

Commercial feedlot sites are located thru out the United States and have been constructed on various soil types and geologic structures. Shuyler and Associates (29) point out that soil types and underlying geologic structures should be considered for each potential feedlot site, to insure maximum protection from groundwater pollution.

Highly permeable, loose soils, shallow water tables and shallow soils over fractured bedrock should be avoided in the feed pen areas, runoff and solid manure storage and field disposal sites. Contamination of groundwater is harmful, not only from a bacteriological standpoint, but also from nitrate poisoning, which can effect both humans and livestock. (29)

Figure 16.



Buffer Zone for Commercial Feedlot Operations

Heavy, fine particled, expanding tight soils, with a low filtration or percolation rate, are ideally desirable for feedlot site location. Some states have established regulations for the allowable percolation rate of soils for feedlot operations. Soils with percolation rates in excess of 0.1 acre foot per acre per year are considered undesirable. (29)

If suitable soil conditions do not exist, soil sealants can be introduded to reduce percolation rates. It is fortunate that cattle manure acts as an effective soil sealant, when allowed to accumulate to a depth of 2 to 4 inches in feed pen areas. Cattle movement tends to compact this interface layer, which does not allow water to percolate through to subsoil structures. Liquid runoff detention ponds are also effectively sealed against percolation by small manure particles in feedlot runoff. (37)

Although soil types and geological structures should be considered in feedlot site selection, this factor is perhaps, not as important as other considerations, as soil percolation rates can be effective controlled. If feedlots are kept properly stocked and proper waste management practices followed, there is little likelihood that nitrate or other soluble pollutants will percolate through the soil profile to the water table, even when it is at a very shallow depth. (37)

Availability Factors

As pointed out earlier, feed crop sources, feeder cattle sources, markets, transportation routes and the availability of utilities are important factors to consider in the selection of a site for a commercial feedlot. The location of a feedlot is more often determined by the availability of feed crops and markets than by climate. However, the climate may frequently discourage feedlot owners from locating in areas of abundant feed and cattle sources. The location of a feedlot may be determined, in some cases, as much by feed crop sources, as by any other single factor. (7)

Feed Crop Sources

Cropland requirements for a 10,000 head capacity commercial feedlot operation can approach 10,000 acres or approximately 15 square miles. Feed requirements for a 10,000 head capacity feedlot, operating at 90 percent of capacity, with an annual turnover rate of 2.5 times are: (35)

Corn silage	8,579 tons
Corn, milo, wheat	1,133,305 bushels
Alfalfa	3,247 tons
Protein supplement	2,468 tons
Fats and salts	475 tons

Assuming a 20 ton per acre yield for corn silage; a 125 bushel per acre yield from grain crops, and a 1.5 ton per acre yield for alfalfa (4 times a year), total crop production area required is 10,035 acres: (38)

Corn silage	428 acres
Corn, milo, wheat	9,066 acres
Alfalfa	541 acres
Total	10,035 acres

Protein supplement, fats and salts are obtained directly from the manufacturer and do not require additional acreage. Exclusive ownership, by the feedlot, of total crop production acreage may not be desirable or economically feasible and would have to be considered against direct grain purchase and land ownership costs. According to Wendling (27), direct feedlot ownership of the total crop production land is not economically desirable, or necessary, as the feedlot operation provides a ready market for adjacent farmers feed crops.

However, it is extremely important to locate the feedlot near abundant sources of feed crops, from an economic point of view. As pointed out in

Chapter 3, finished beef production closely parallels the corn and sorghum producing areas of the United States. It is also important to locate the feedlot in an area where several feed crop sources are available, in case of a particular crop failure due to climate and/or disease.

Feeder Cattle Sources

The location of a commercial feedlot is not greatly influenced by the source of feeder cattle, as they can easily be transported by rail or truck. It is, however, important to recognize the competition among buyers for one source of cattle and therefore this factor should receive serious consideration when selecting the location for a feedlot. (7) Figure 17 indicates the sources and movement of feeder cattle to the finished beef producing areas of the United States.

Markets

Commercial feedlot locations should be close to consumer markets and slaughter facilities to provide economic advantages in moving finished cattle. Cattle can be supplied on short notice to packing houses and freight charges are reduced by close proximity to markets. However, the nearness to market can result in higher costs, in regards to land, taxes and environmental pollution control systems. Therefore, it is necessary to balance the advantages of close location to markets against the cost factors of locating in remote areas. (7)

The feedlot location should ideally be located within the proximity of several markets, equi-distant from the feedlot to take advantage of differences in market demand and prices. As pointed out in Chapter 3, packing facilities have located in finished beef producing areas to reduce production costs. Some larger feedlot operations actually incorporate packing facilities within the feedlot operation, as evidenced by the Monfort Cattle Company, Greeley, Colorado. Present highway systems and truck transportation have allowed feedlots to locate in remote areas, as far away as 400 miles from markets, and still yield a profit to feedlot owners. (39)

Transportation Facilities

A heavy demand has been placed on truck transportation by the feedlot industry, therefore, requiring that feeding facilities be located in areas that are served by major arterial highways and good secondary roads.

Moving cattle by trucks is presently the most common method of transportation. According to Gustafson and VanArsdall (40), in 1919, trucks moved 2 percent of the cattle shipped to public markets as compared to 97 percent in 1967.

The advantages of the truck over rail, as determined by Capenar and Associates (41) are: 1) accessibility to most areas. 2) flexibility in load capacities. 3) convenience of availability. 4) reduction in transit hauling time, and 5) a reduction in the number of loadings and unloadings. Although the movement of cattle by rail has declined, rail facilities are still a desired factor in feedlot operations for the movement of feedstuffs.

Utilities

The commercial feedlot of today requires the ready availability of water, power (electricity) and gas to operate successfully. These are important considerations in feedlot site selection.

According to Winchester and Morris (42), a 1,000 lb. feeder steer requires 10 to 20 gallons of water per day. A 10,000 head capacity feedlot will require approximately 100,000 to 200,000 gallons of water per day. Feedmills, with steam-flaking equipment will require additional amounts of water daily. To meet this demand, water sources, with a continuous pumping capacity of

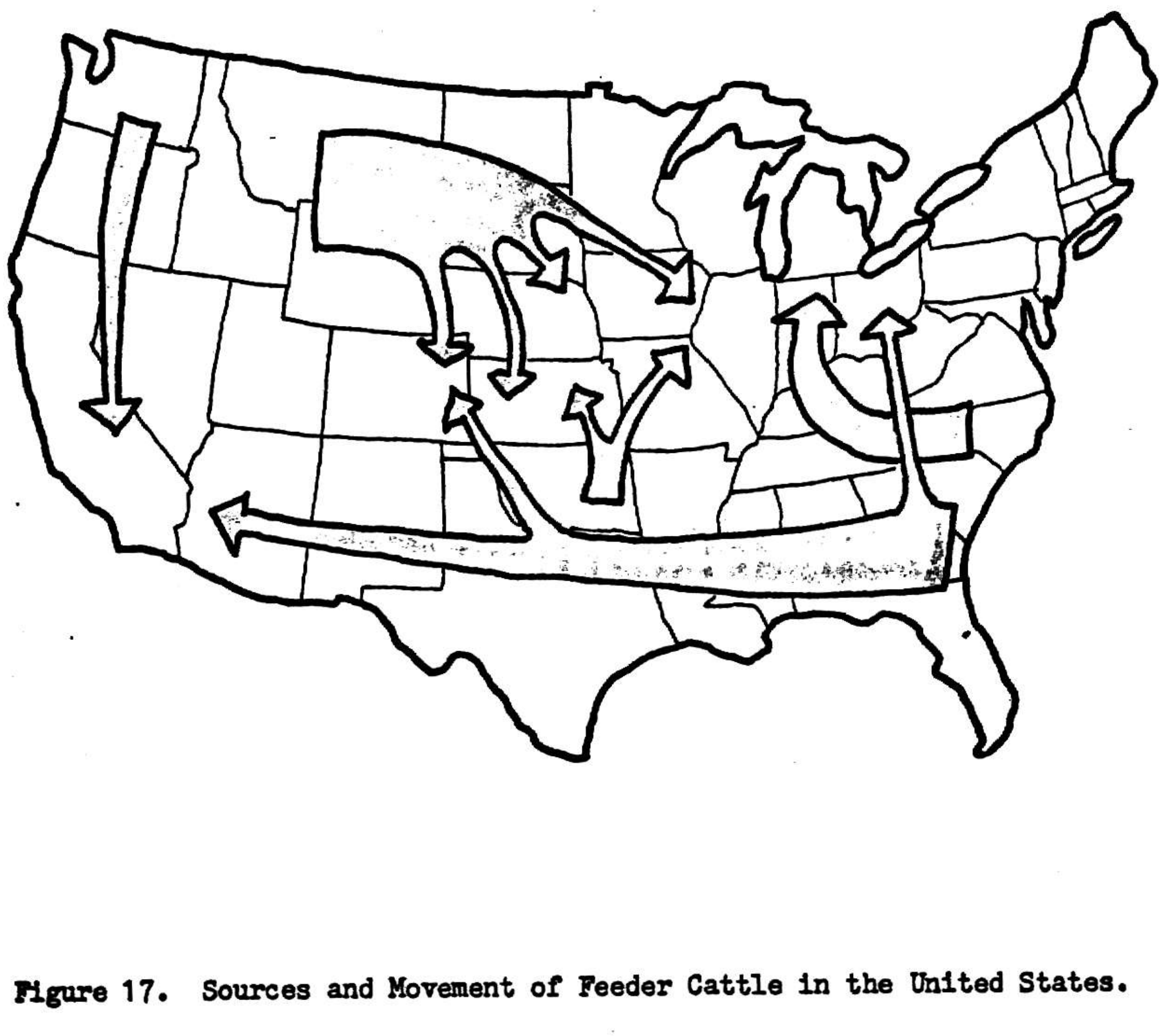


Figure 17. Sources and Movement of Feeder Cattle in the United States.

approximately 170 gallons per minute are required. (23) Therefore, it is extremely important to locate the feedlot on a site that has an adequate supply of water.

Almost all of the commercial feedlot's operations and functions require electricity and gas to operate. Although most feedlots have emergency power generating systems, an adequate supply of electricity and gas should be considered in site selection. (7)

CHAPTER 7

REVIEW AND ANALYSIS OF COMMERCIAL FEEDLOT OPERATIONS AND EXISTING SITE CONDITIONS

At this point in the study, field trips into major, finished beef producing areas, were undertaken to gain a thorough understanding of feedlot operations. The field trips provided the opportunity to: 1) review and analyze existing commercial feedlot operations and site conditions; 2) determine specific site planning and operational problem areas, relative to the study; and 3) establish a photographic record for further study.

Approximately 20 feedlot sites were reviewed, the capacity of the largest feedlot was 50,000 head, while the smallest feedlot was approximately 1,000 head. Both individual and corporate feedlots were visited. Informal personal interviews, with the feedlot owners/managers, were conducted to determine to what extent they were concerned with the impact of their operations on the environment, from a visual, as well as pollution standpoint.

Field Trips Summary

The results of the field trips and personal interviews can be summarized as follows: Commercial feedlots require a sizeable amount of land for the operation. The location of the feedlot sites varied from within one mile of populated areas, to 25 to 30 miles away, in remote agricultural land areas. Sites were located north, east, south and west of urban areas. Some were located along major arterial highways and others along paved and unpaved secondary roads. Setback distances, from these roads, varied from none to approximately 1,000 feet.

Due to the relatively flat topography of the areas, some feedlot operations could be seen from 2 to 4 miles away. Others were not visible until approximately one-half to 1 mile away. In all cases, the feedlot operations were clearly visible from public roads.

Site organization and pen arrangement also varied with each site, depending upon topography and the age of the feedlot. Older feedlots, over 10 years, tended to be developed in a random manner, flowing along existing slopes and terrain. Newer feedlots, under 10 years, indicated a greater degree of organization and pen arrangement, taking into account newer methods of site planning and land forming for improved drainage and operational efficiency. All of the feedlots reviewed had modern feed mills and supporting feed equipment. Feed alleys were oriented in every direction, however, the predominant orientations were either north-south or east-west. Administration areas were, in some cases, clearly visible, and in others, difficult to find. Weight scales were generally incorporated near the administration area to provide convenience in weighing and recording feedstuffs and cattle. Roughage storage, equipment storage and cattle shipping and receiving areas tended to be located near the feed mill and administration areas. Liquid runoff detention structures and solid manure storage areas were generally located to the rear of the operations, but in some cases, these facilities were again, clearly visible from public roads.

General Problem Areas in Feedlot Site Planning

Two general types of problems are generated by commercial beef cattle feedlot operations: 1) functional operation problems which involve public safety at access roads, site entrances and interior working areas, in addition to atmospheric nuisances of noise, dust and odor. 2) visual image and appearance problems, which concern the physical condition and characteristics of the feedlot operation, its structures, site organization, site details and planting arrangements. Improper planning can result in these problems, plus poor relationships with the surrounding environment and undesirable site appearance.

According to Baxter (43), large industrial sites can be broken down into three areas which are responsible for public image and visual quality. A comparison of large industrial sites and commercial feedlot operations indicates that these different industries possess similar characteristics of massive land use, large structures and excessive vehicular traffic. Therefore, these three areas of image and visual quality are applicable to commercial feedlot operations.

Image Area 1 considers the majority of the public viewers and influences them as they drive past the site, on public highways and roads. Visual problems concern site organization and appearance. Functional operation problems involve public safety in the movement of vehicular traffic to and from the site, onto the public highways and roads. Design solutions, in this area, require land forming, planting arrangement and site organization to provide interesting views upon the site. Proper construction of entrance and access roads, mergence lanes and sight-travel distances are also required.

Image Area 2 concerns the area surrounding the site and involves a smaller number of public viewers than Image Area 1. However, this minority is instrumental in the forming of public attitude to future and present acceptance of commercial feedlot site operations. Design solutions, for this area, must consider the stationary viewer and provide views upon the site that are pleasing in appearance, while controlling atmospheric nuisances of noise, dust and odor. Transition zones, visual screens and land forming can be utilized as effective design solutions.

Image Area 3 involves the interior areas of the site, which influences the public visitor, clients and employees. Concern must be given to operational function as well as public image. This area combines the problems of Image Areas 1 and 2. Design solutions must consider public safety, traffic circulation, visual appearance and nuisances of dust, noise and odor. Site organization, site detailing, planting arrangements and land forming must provide traffic direction, drainage, spatial definition and insure public and employee safety.

Site planning, for commercial feedlot operations, to be effective, must consider each of these Image Areas, Figure 18. The success of the operation is directly related to the degree of which each area is considered.

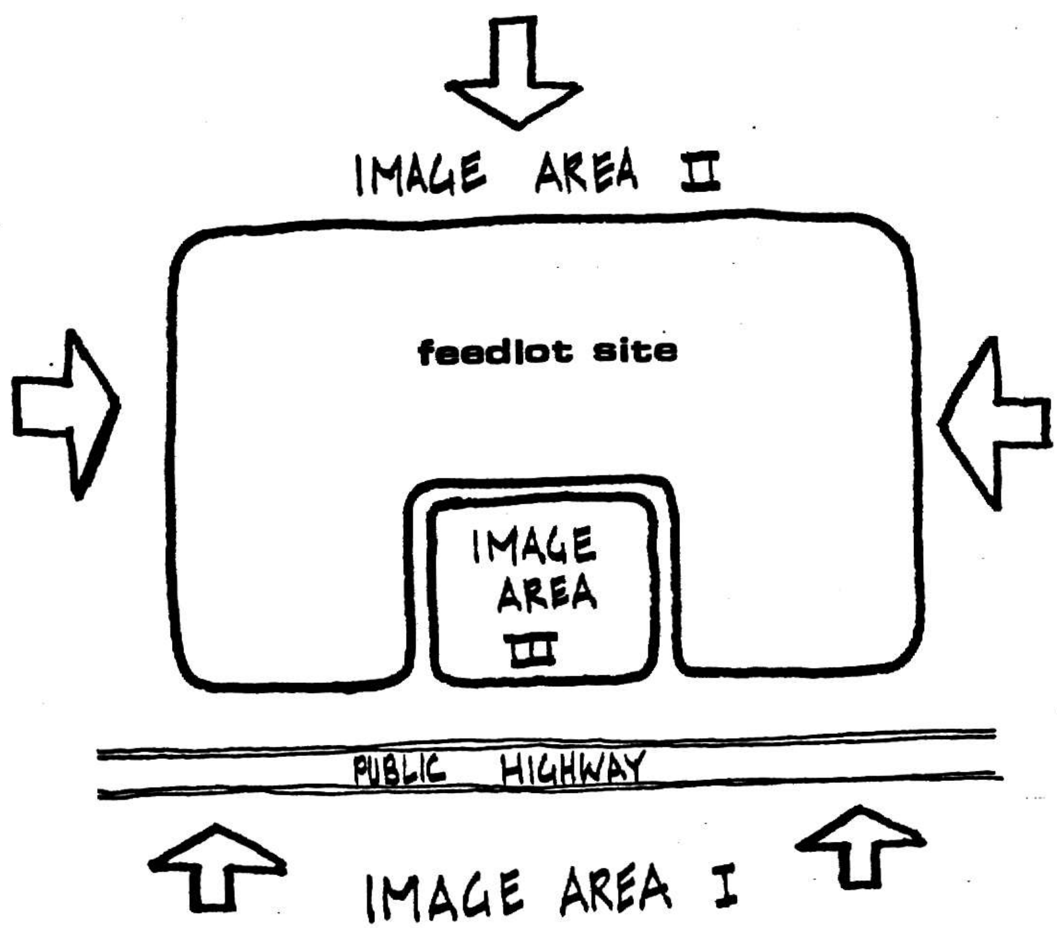


Figure 18. Image Areas of Commercial Feedlot

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THIS BOOK CONTAINS NUMEROUS PICTURES THAT ARE ATTACHED TO DOCUMENTS CROOKED.

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Specific Site Planning and Operational Problem Areas

In addition to the forementioned general problem areas in commercial feedlot site design, specific site planning and operational problem areas, were observed during the field trips. Relative to this study, the specific problems areas, illustrated by photos, are:

1) Overall site appearance lacking in visual quality, Figure 19.

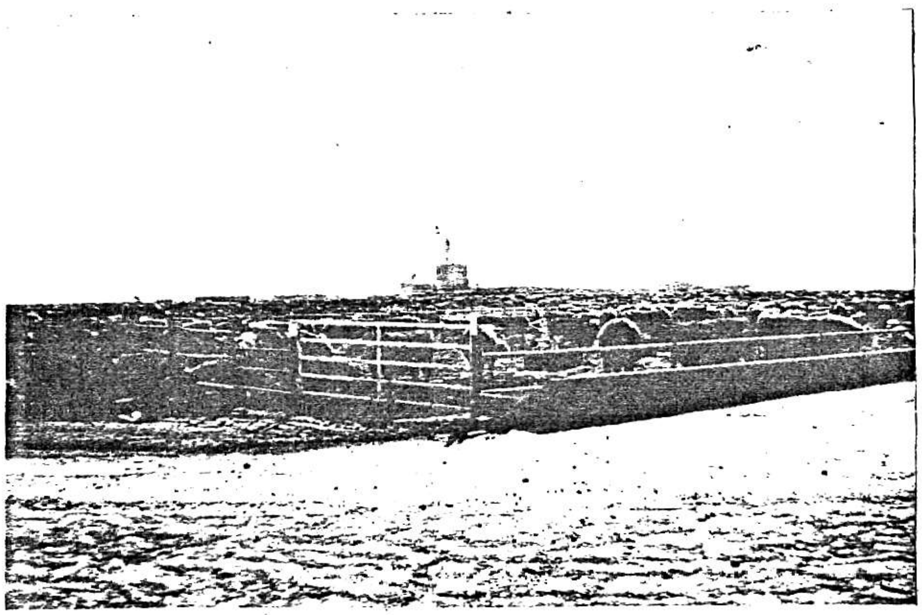


Figure 19

2) Setback distances, from existing highways, inadequate and/or lacking in visual quality and vegetative screenings, Figure 20.

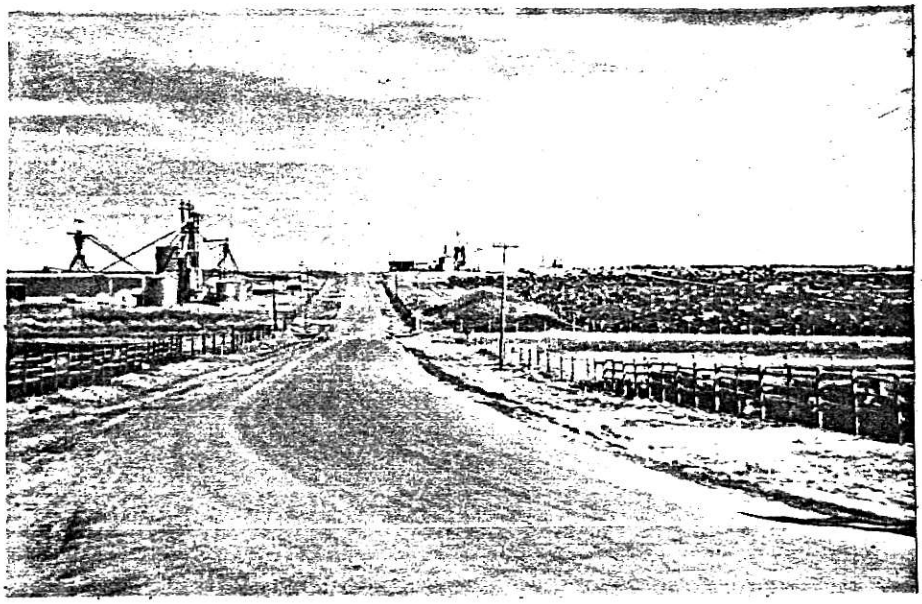


Figure 20.

3) Site entrances and access roads unclearly defined, Figure 21.

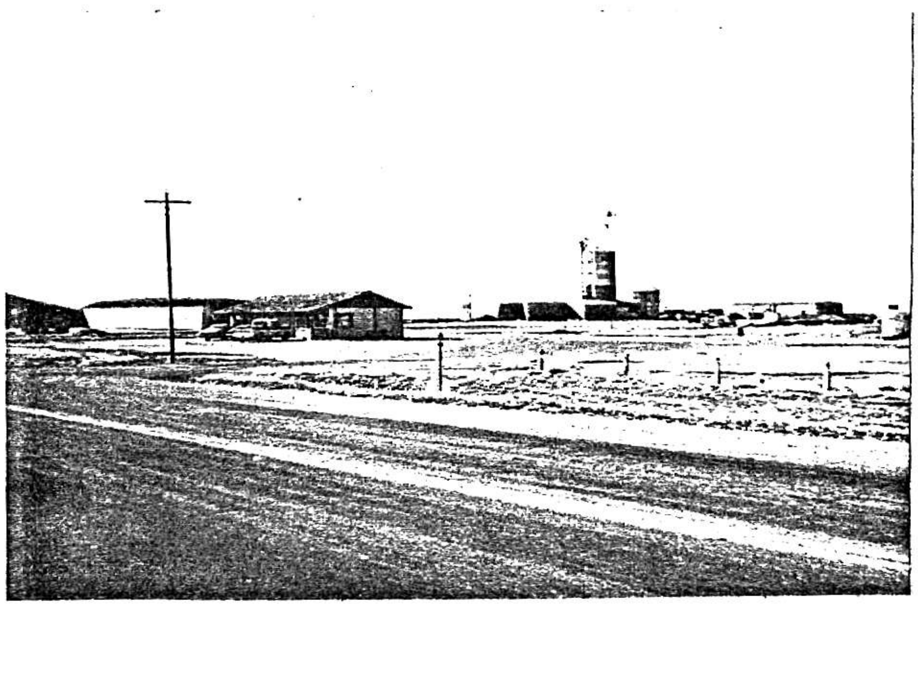


Figure 21.

4) Unlimited visual exposure of interior site operations, from public roads, Figure 22.

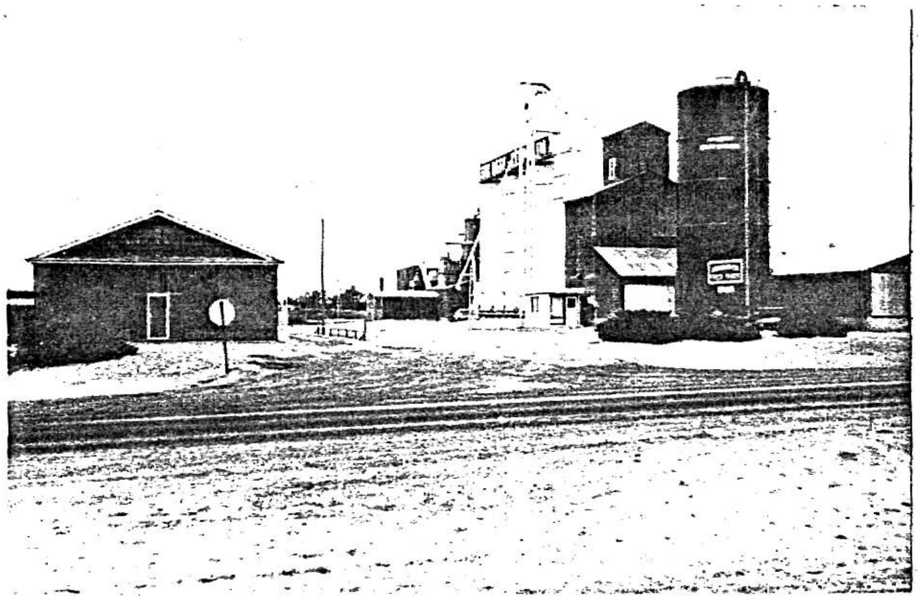


Figure 22.

5) Spatial definition and visual quality of interior site operations not developed to fulless potential, Figure 23.

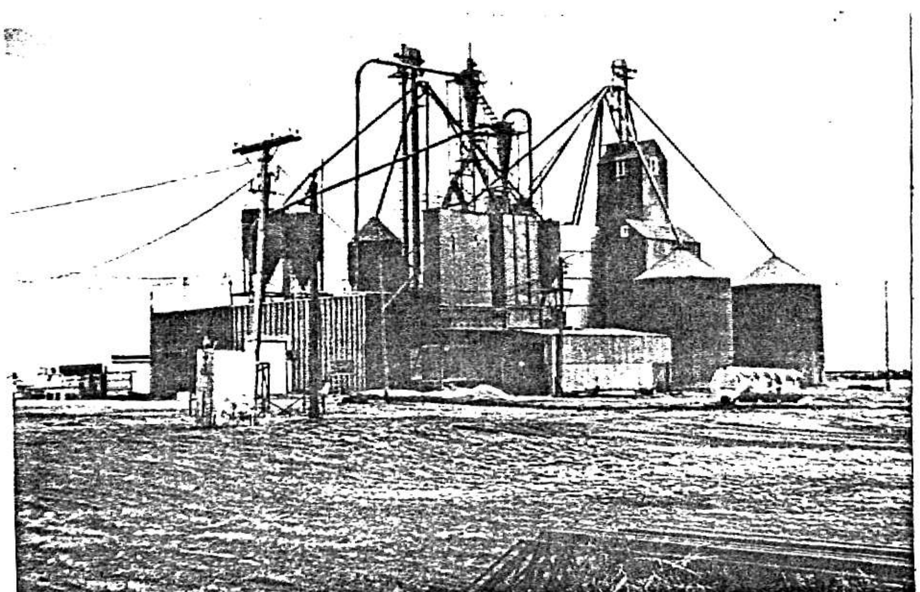


Figure 23.

6) Atomspheric nuisances of dust, odor and noise, present in most site operations, Figure 24.

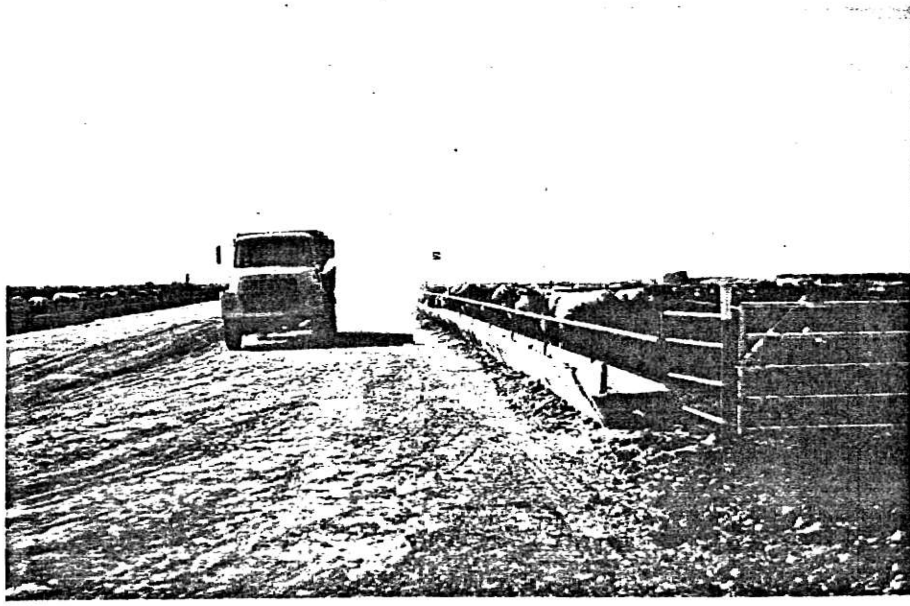
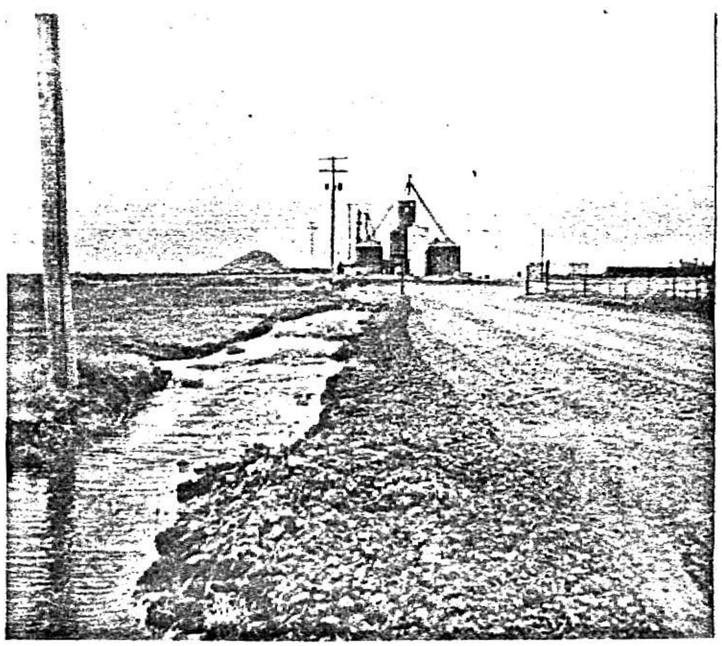


Figure 24.

7) Drainage problems, created by low spots, near public and interior site roads, Figure 25.



8) Plant materials and vegetative screening were, largely, non-existant in site operations and planning, Figure 26.

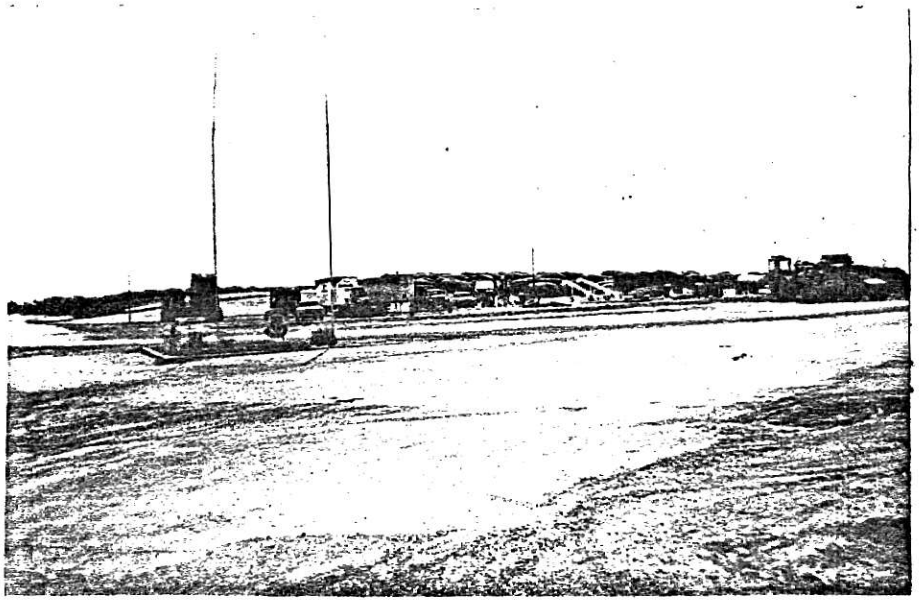


Figure 26.

9) Inadequate site maintenance programs, Figure Figure 27.

10) Sprawling, horizontal character of feedlot operations in need of visual quality planning, Figure 28.

Figure 28.

Although these specific problem areas, in site planning, were identified, they were more prevalent in some operations, than in others. The majority of the feedlots reviewed, had a 'kept' appearance, indicating that feedlot owners and managers are concerned with the visual and public image of their operations.

Personal Interviews

Almost all of the feedlot owners and managers interviewed, indicated that environmental considerations should be taken into account in their operations, especially in this environmentally conscious age. There was a definite concern expressed, for the site appearance, visual quality and public image of their operations. The feedlot owners and operators, indicated that there was a specific need for environmental site planning, in the commercial feedlot industry, that would enhance the functional aspects of the operations, and at the same time, improve the unfavorable public image that presently exists.

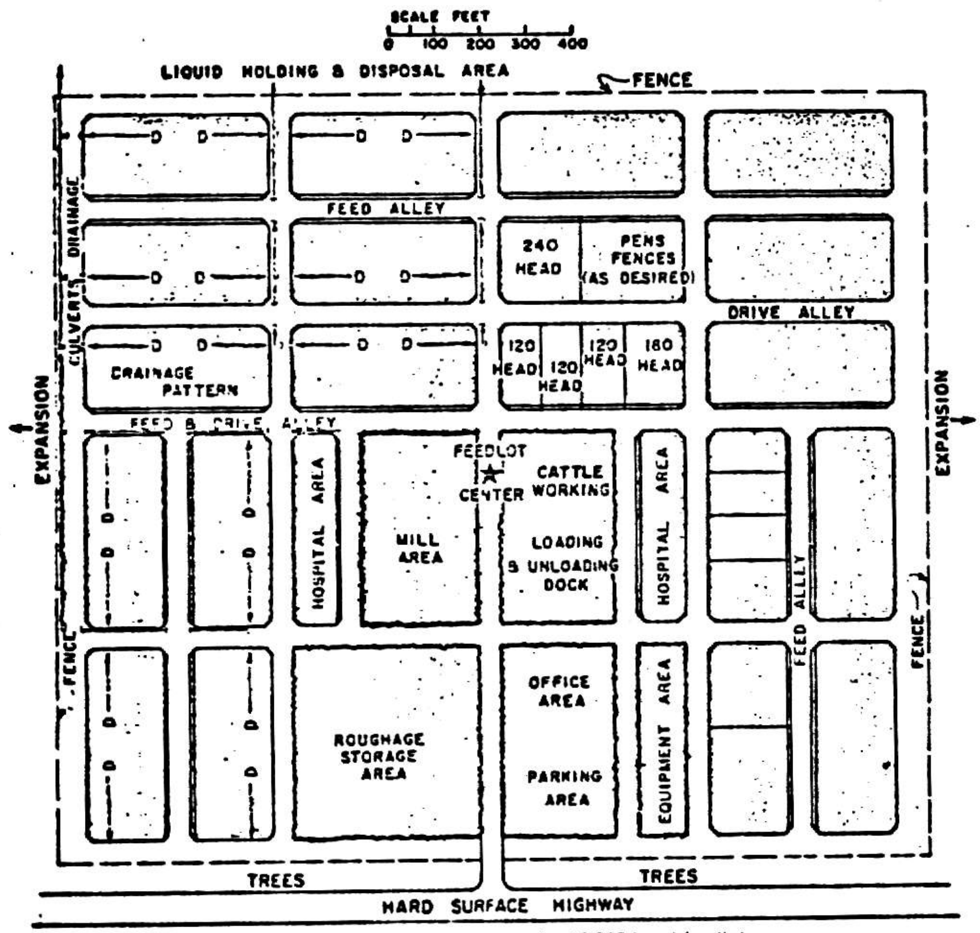
However, extensive site planning programs, to improve the environmental quality of feedlot operations, are not being undertaken, presently, within the industry, for the reasons of: 1) not having the technical knowledge to effectively solve problem areas; and 2) this type of planning is considered secondary to the functional aspects of the feedlot operation.

It is unfortunate that such site planning is not considered at the same time as functional planning, as functional relationships and environmental quality can and should be considered together. Separation of these considerations can result in unfavorable functional relationships and environmental quality.

Site Organization

Site organization of the commercial feedlot operation is very important for efficiency and total site appearance. According to Oklahoma State University research (44), an ideal feedlot design and site organization is U-shaped, with the administration, feedmill, equipment and other support operations located near the center of the 'U'. The feed pens should be located around the operational center, as shown in Figure 29. This type of site organization offers the most efficient layout. (44) The feeding pens should be located on three sides of the activity center, with the fourth side connected to a public road.

This organization allows for a free flow of livestock, feed and vehicular traffic to and from the feedlot facility. The site should be rectangular, with the side fronting the public road, the widest. The depth of the layout should be about 80 percent of the frontal width. Proper design can reduce travel distances, by approximately 25 per cent, when compared to unplanned layouts. As a result, annual operating cost, in a well-designed feedlot, can be reduced by 6 to 10 per cent. (44)



Suggested layout for 10,000 head feedlot.
Drainage pattern indicated on left; pen divisions on right half of sketch.

Figure 29. Ideal Layout for 10,000 Head Capacity Commercial Feedlot.

Components of the Commercial Feedlot

Commercial feedlots, over the years, have been designed and arranged in as many different sizes and shapes, as there are sites. Regardless of the physical shape of the feedlot, the basic components of the operation remain the same. For purposes of this study, the components are divided into: 1) public; and 2) private or operational components.

Public components of the commercial feedlot are: 1) the perimeter 'buffer' zone; and 2) the site access and entrance areas. These components are more subject to public exposure and scrutiny than the other components, and are largely responsible for the formation of public images toward the industry. Therefore, design solutions in these areas should emphasize public safety and visual quality (Image Area 1).

Private components of the commercial feedlot are: 1) the administration area, 2) feed mill, 3) cattle shipping and receiving, 4) roughage storage, 5) equipment storage/maintenance, 6) feeding pens, 7) feed and drive alleys and 8) liquid and solid manure storage areas. These components should be considered private in nature and therefore, public exposure should be controlled to prevent unfavorable public images and attitudes from developing (Image Areas 2 and 3).

Up to the present time, most feedlots have been designed, from only the functional aspect of the operation. Visual quality and environmental planning have been given minimum consideration. Since commercial feedlot operations tend to be stationary, it is important to develop the site for efficient operation and environmental quality.

DEVELOPMENT GUIDELINES FOR THE PUBLIC COMPONENTS

Perimeter 'Buffer' Zone

As pointed out in Chapter 6, the commercial feedlot site should be surrounded on all sides by a large 'buffer' of crop land, under direct control or ownership of the feedlot, to prevent encroachment, and to provide areas for waste manure disposal. In addition to the large cropland 'buffer', a smaller perimeter ' asethetic buffer' should be provided directly adjacent to the feedlot site, Figure 30. This concept, being of Japanese origin, is presently used by large industrial firms such as U. S. Steel, to improve the visual appearance, environmental quality and public image of their sites. (45)

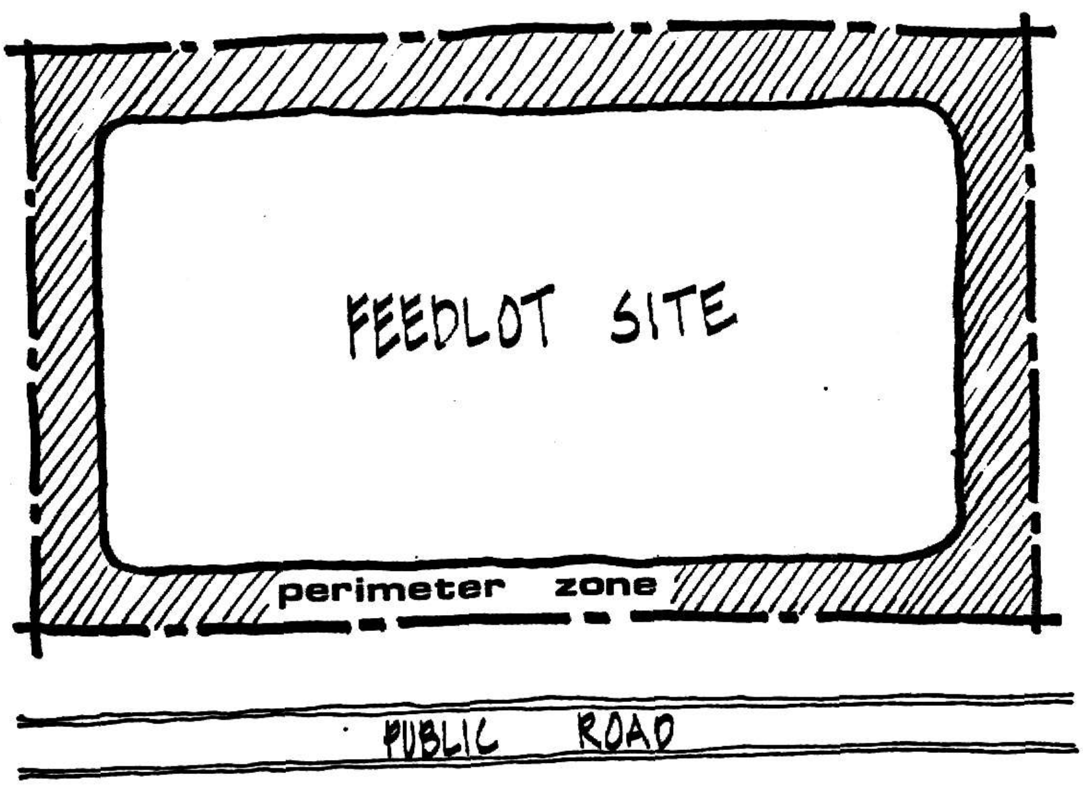


Figure 30. Perimeter 'buffer' Zone.

The perimeter 'buffer' zone is very important to the total development of the commercial feedlot site, and directly affects the public's attitude toward the operation. Therefore, the perimeter 'buffer' zone should be carefully considered at the beginning of feedlot site development. Unfortunately, feedlot operations have apparently failed to recognize the importance of the perimeter zone during site development. Most of the feedlots, reviewed during the field trips, did not utilize perimeter 'buffer' zone development.

The primary functions of the perimeter 'buffer' zone are: 1) to provide a location for vegetative screens, windbreaks, drainage diversion ditches and perimeter site roads; and 2) to provide a location for plant materials and land forms that will improve the visual appearance of the feedlot and help to reduce atmospheric nuisances of dust, odor and noise generated on the feedlot site, by cattle and equipment.

According to Shuyler and Associates (29), little can be done to modify animal environments, in open feedlots, as compared to confinement shelters. However, vegetative windbreaks should be utilized to provide some modification of the animals' environment, particularly during winter-time conditions.

Confined livestock should be protected from winter winds by utilizing vegetative windbreaks on the north and west sides of feed pen areas, states Baughman. (46) Prevailing summer wind direction may limit the application of vegetative windbreaks on the west side of confined livestock feeding operations, especially if the summer wind direction is frequently from the southwest. Summer wind movement is desired in feedlot operations to help reduce heat stress on animals and to keep feed pen conditions as dry as possible.

The installation of vegetative windbreaks (rows of densely spaced trees) should be located in the perimeter zone to effectively block cold, winter winds that could, otherwise, cause stress on livestock and increase production costs, Figure 31.

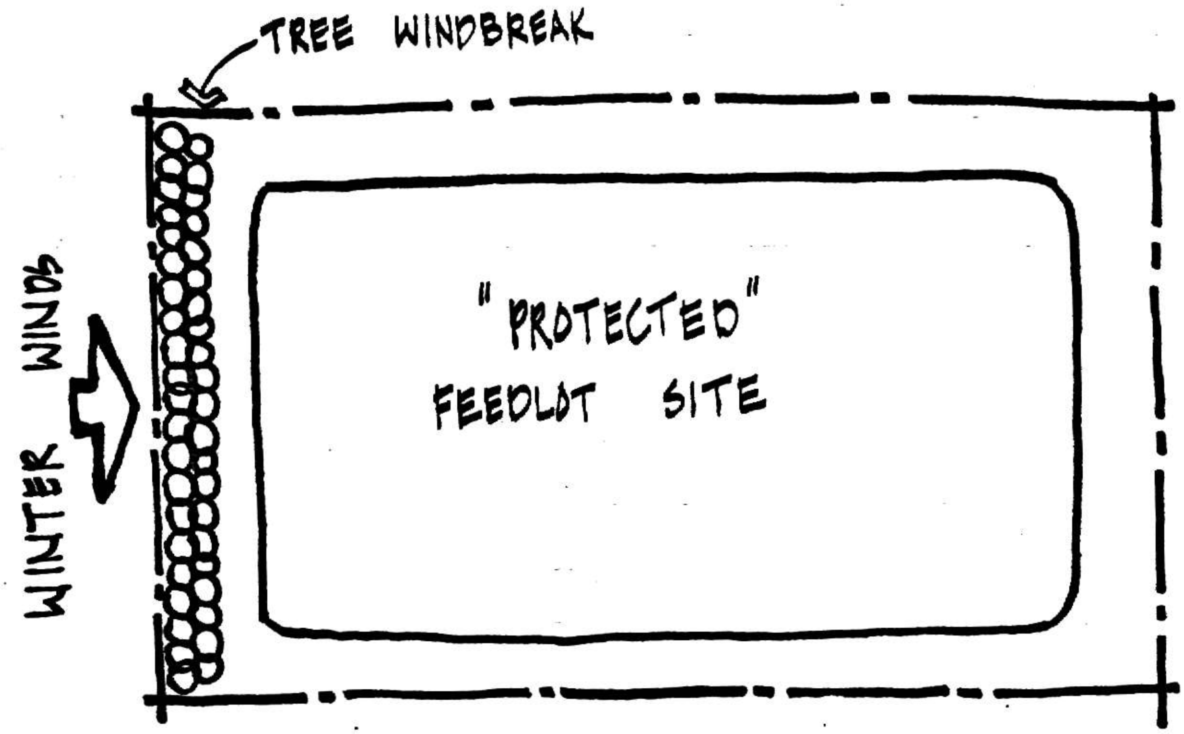


Figure 31. Perimeter Zone with Vegetative Windbreak.

Research has shown that windbreaks can effectively reduce the velocity of winds, an average of 50 per cent, for horizontal distances, equal to 30 times the vertical height of the windbreak, Figure 32. The most protection is provided, in horizontal distances, 20 times the vertical height of the windbreak. (47)

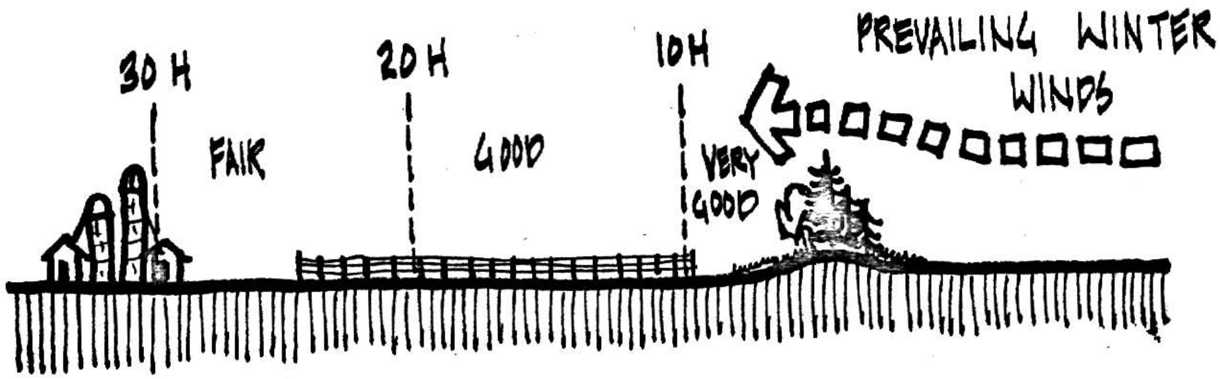


Figure 32. Windbreak Protection.

In the publication, Windbreaks for Kansas, Baughman (46) indicates that vegetative windbreaks provide many benefits to farms and ranches. They reduce wind speed, control snow drifting and create a more pleasant environment. Snow drifting and prevailing winter winds can be controlled by the installation of several rows of densley spaced evergreen and tall deciduous trees. Three to five rows of trees, primarily evergreen, are usually adequate to provide winter protection for livestock. The main evergreen plantings should always be on the windward side of tall deciduous trees, to best control snow drifting, Figure 33.

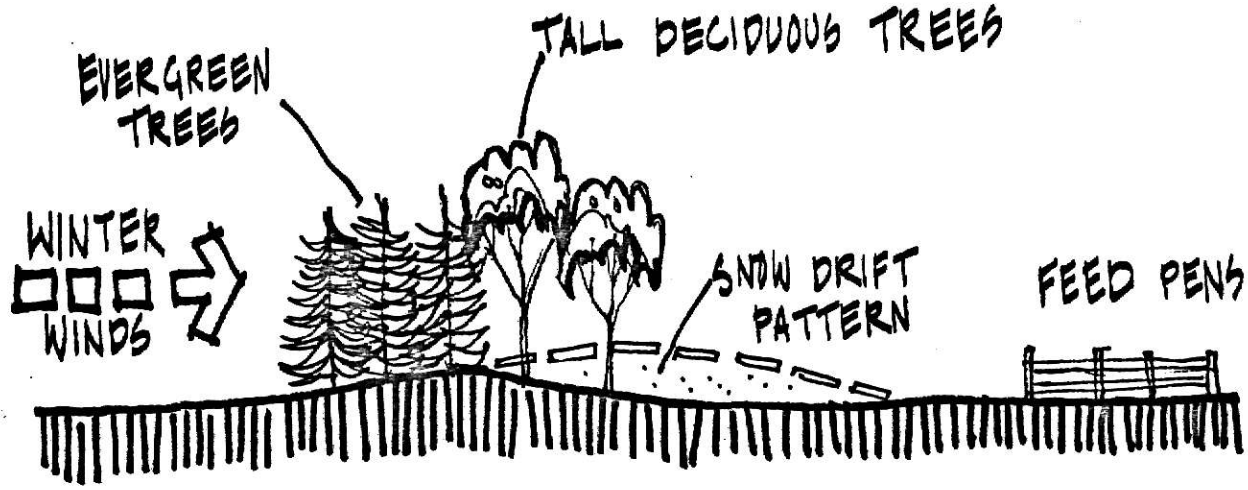


Figure 33. Windbreak Structure.

Windbreaks designed for winter wind protection should be located at least 100 to 150 feet from buildings, roads or livestock. (46) The distance from the windward side of the windbreak, to the nearest building, road or feed pens, should be a minimum of 185 feet, Figure 34, to prevent snow drift patterns from reaching use areas, according to Johnson (48).

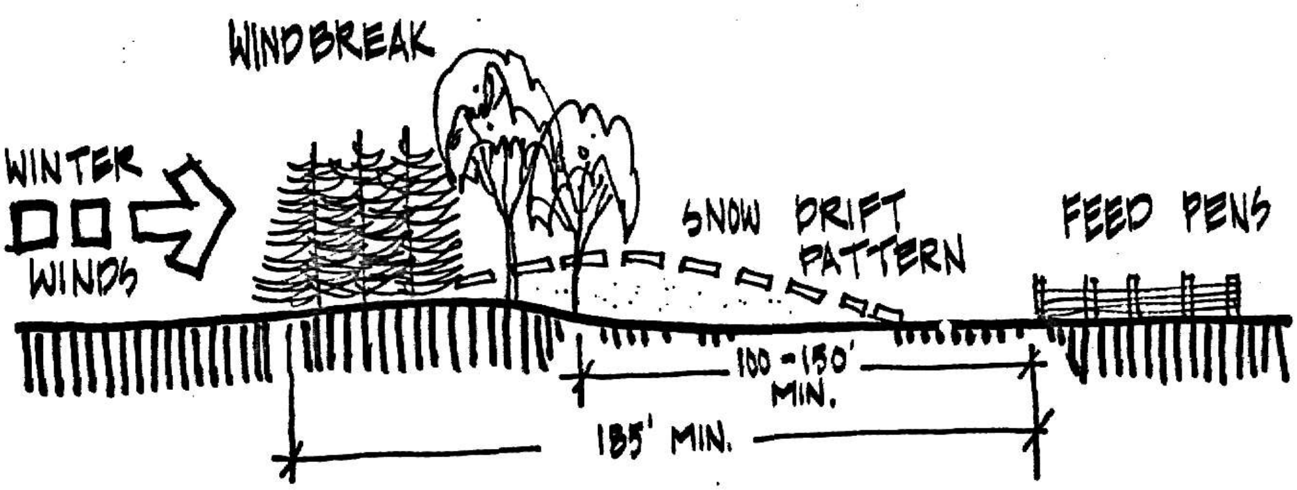


Figure 34. Windbreak Structure for Snow Drift Control.

Between-row spacing will vary for different locations, Figure 35, however, a spacing of 20 to 25 feet, is usually adequate to prevent stunting and over-topping plant material growth. In-row spacing will also vary with the type of plant material:

Shrubs	3 to 6 feet
Red cedar & Juniper	8 to 12 feet
Pine	10 to 16 feet
Short deciduous trees	8 to 12 feet
Large deciduous trees	12 to 18 feet

Wider spacings are best for multiple-row windbreaks, while closer spacings offer more protection in windbreaks, of one or two rows. (46)

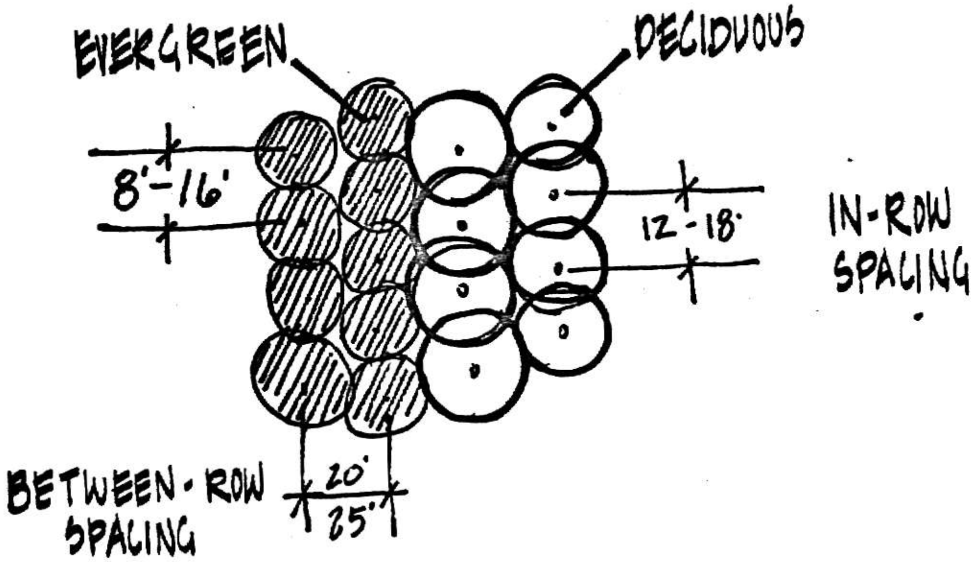


Figure 35. Windbreak Spacings.

Surrounding the feedlot site, with densely spaced plant materials, is not desired, as prevailing summer winds should be allowed to flow freely through the feed pen areas. Therefore, careful placement and selection of plant material, as well as land forming, is necessary for desired wind movement. Baughman (46) indicates, that summer wind movement, from the south side of feed pen areas, should not be blocked with dense tree rows. However, hot, dry, summer winds can be filtered somewhat, by deciduous trees, planted on the south side of these areas. Trees, on the south side of feedlot sites, can be located closer to buildings, roads and feed pens, as snow drifting is not a problem.

Ocassional groupings of tall, deciduous trees such as, cottonwood, hackberry and honeylocust, located on the south side of feedlot sites, with open-spacings of 50 to 100 feet, will tend to improve the visual appearance of the feedlot operation. These tall, deciduous trees will permit air movement to pass through and under the branching structures, without excessive wind speed reduction, Figure 36.

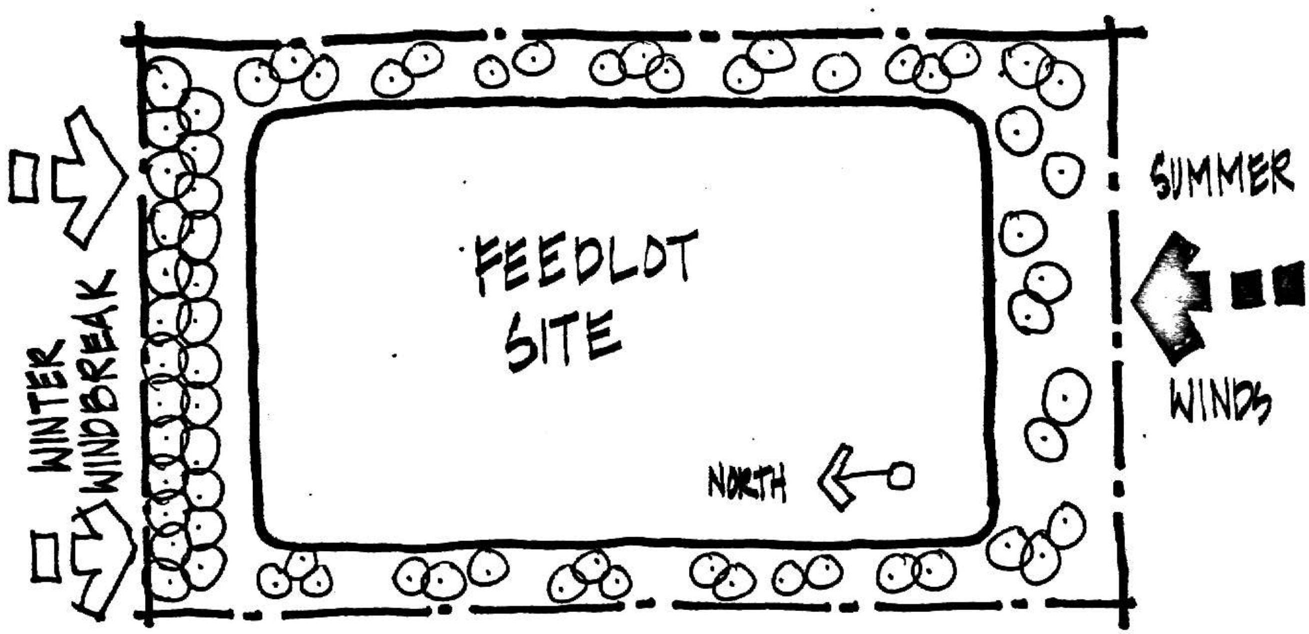


Figure 36. Perimeter 'buffer' Zone Plantings

Perimeter 'buffer' zone development, along the east and west sides of the commercial feedlot operation, may include such plant materials as; redbud, russian olive, austrian pine and eastern red cedar, in addition to tall deciduous species. Since these sides of the feedlot operation are parallel to the direction of most summer prevailing winds, these additional plant materials, can be introduced to provide visual screening, especially if public roads are present, Figure 37. A mixture of 40 per cent tall deciduous, 40 per cent small deciduous, and 20 per cent evergreen should produce the desired visual screen. Extreme density of plant materials is not necessary to produce visual quality in screening.

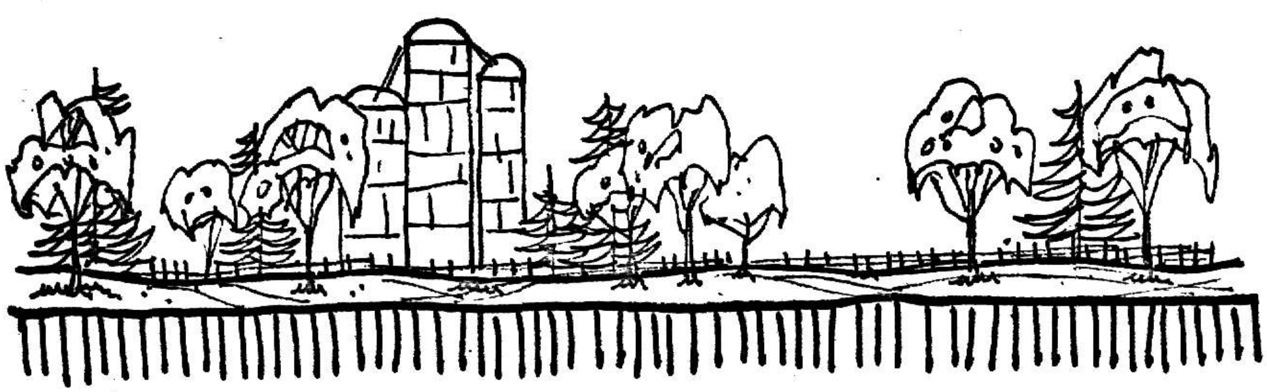


Figure 37. Section of Perimeter 'buffer' Zone Planting.

Air temperatures, directly over a feedlot, are generally several degrees warmer, than surrounding areas, due to heat generated by solar radiation on bare soil, cattle and decomposing manure. (49) Research (47) shown that summer air temperatures can be reduced by as much as 3 to 5 degrees, by large canopies of tree foliage, and by 10 to 14 degrees, by grass covered surfaces. Therefore, it appears feasible to incorporate as much 'green space' as possible, in and around the feedlot site.

The perimeter zone provides the opportunity, for the installation of such tree canopies and grass surfaces, to help reduce the temperature of the air, over the feedlot, for increased cattle comfort and minimum weight losses, Figure 38.

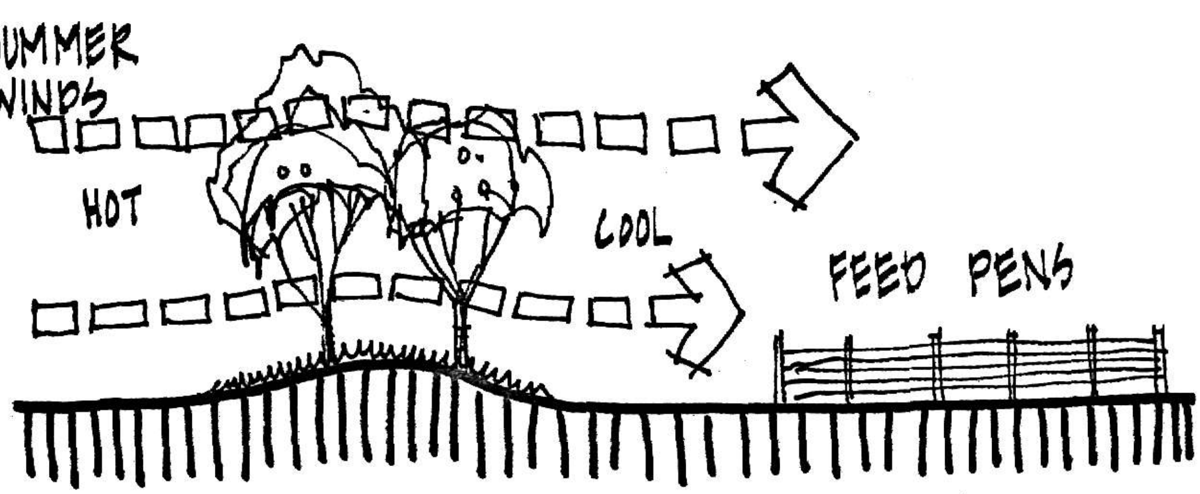


Figure 38. Perimeter Zone Planting for Summer Wind Movement.

Plant materials and land forming, located in the perimeter zone, in addition to providing wind protection and visual quality, serve the function of reducing atomospheric (nuisances) pollution, that is created within the feedlot site, Figure 39. Robinette (47) points out that plants play an important role in helping to reduce particles of pollution in the air.

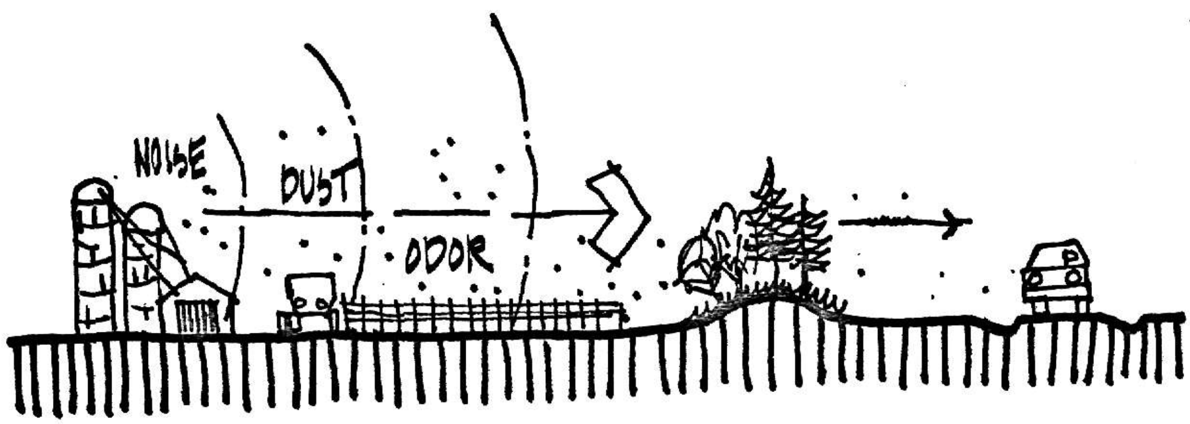


Figure 39. Plantings to Absorb Atomspheric Pollution.

Research has shown that the foliage and structural mass of trees, shrubs, ground covers and land forms (berms), when used in combination, can absorb up to 65 per cent of unwanted noise and effectively reduce dust and odor quantities in the atomspheric. (50) Extensive research has been conducted, by the University of Nebraska, on noise abatement properties of plant materials, which substantiates the above. (51)

The perimeter 'buffer' zone provides an ideal location for drainage diversion berms and channels. Butchbaker and Paine (32) state that, the first step in the control of feedlot runoff, is to prevent off-site, surface water from entering the feedlot site. Drainage from land areas, up-slope from the feedlot site, should be diverted around the site, to reduce on-site runoff amounts, Figure 40.

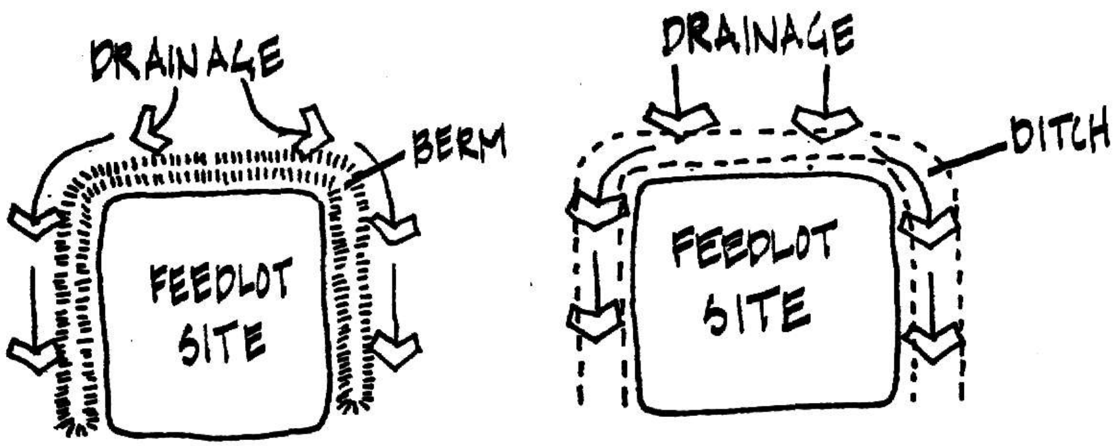


Figure 40. Diversion of Up-slope Drainage.

Since summer-time wind movement is desired, thorough the feedlot site, berm heights should not exceed 5 feet. Berms, six to ten feet in height, can reduce wind velocities by as much as 15 per cent. (52) Maximum slope of berms should be 3 to 1, to permit equipment movement, Figure 41. (53)

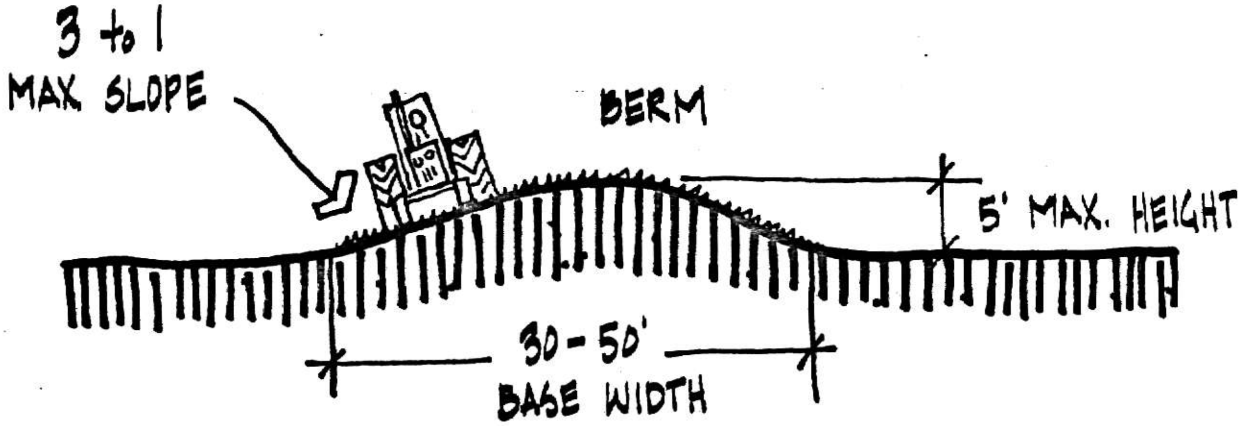


Figure 41. Berm Structure.

Drainage diversion berms should also serve to screen unslightly views of the feedlot operation, Figure 42. Since the eye level of persons traveling in vehicules, along public roads, is approximately 4 feet, berms of 5 feet in height, should adequately screen the major portions of the feedlot operation.

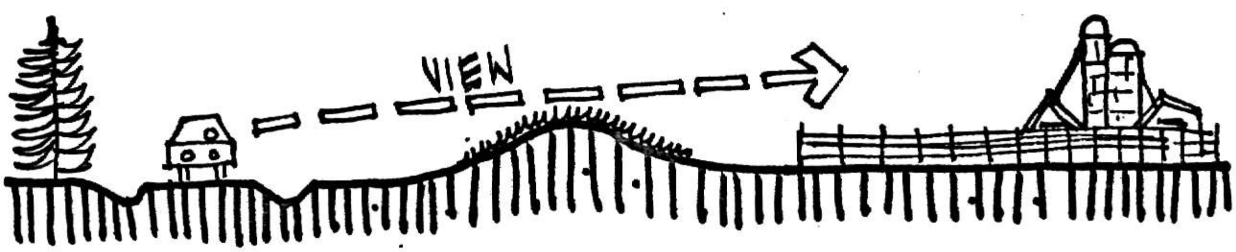


Figure 42. Berm as Visual Barrier and Screen.

Secondary functions of the perimeter 'buffer' zone development include providing a transition zone between different land uses, Figure 43. The perimeter zone also provides additional land for the disposal of liquid runoff and/or solid waste manure.

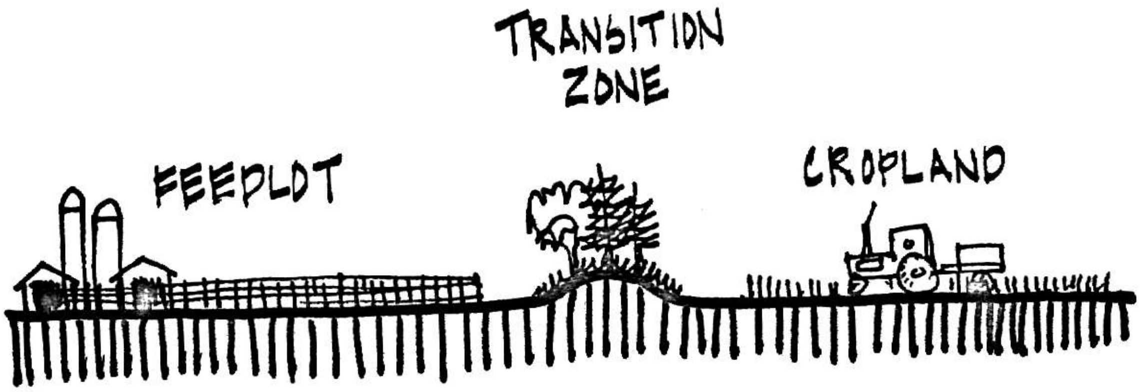


Figure 43. Perimeter 'buffer' Zone as Transition Area.

In an effort to promote the feedlot industry's public image and to allow public visitors to view feedlot operations, without entering the site, 'view stations', with informational signing could be provided in the perimeter zone, Figure 44. This type of development could be utilized in feedlot sites, that parallel public roads for considerable distances.

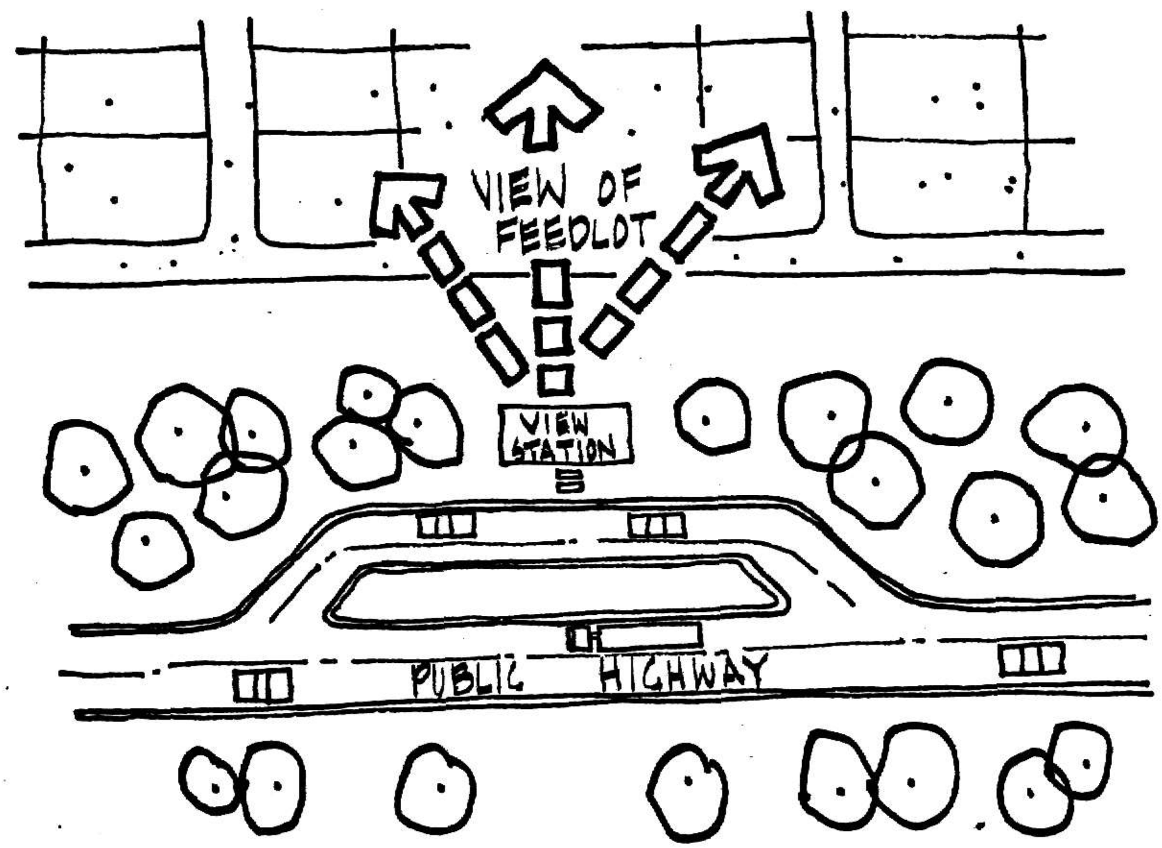


Figure 44. View Station in Perimeter 'buffer' Zone.

The first stage, in the development of the perimeter 'buffer' zone, is to provide adequate space to incorporate plant materials, land forming, drainage channels and perimeter site roads. The minimum width, of the perimeter zone, should be 200 feet, on the sides of the feedlot that face prevailing winter winds. This will allow for adequate space for tree rows and snow drift areas, Figure 45. The minimum width, on the other sides of the feedlot, should be 100 feet, to allow for plant materials, land forming, drainage channels and perimeter site roads. The entire width of the perimeter zone should be maintained as permanent 'green space', by utilizing trees and ground cover plant materials.

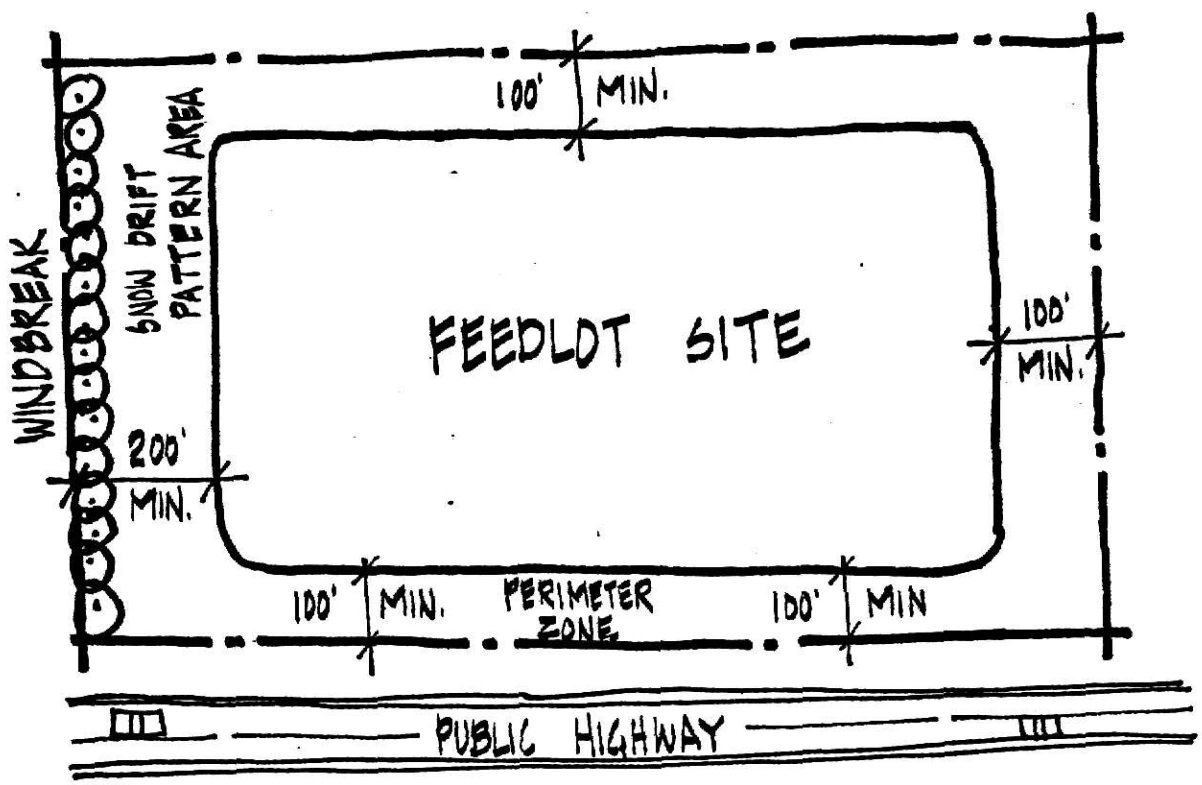


Figure 45. Perimeter 'buffer' Zone Structure.

Topsoil, from the feedlot site, should be stripped, prior to feedlot construction, and utilized to develop land forming, in the entire perimeter 'buffer' zone, as it will provide an excellent growing medium for plant materials. This topsoil, may otherwise, be lost by careless grading techniques or rendered useless, by the nature of the feedlot operation.

The construction of land forming is a relatively simple operation, when the right equipment is used. It seems fortunate that some of the equipment that is utilized by feedlot operations, is well adapted to land forming. Dozers, scrapers and tractors with mounted blades, are very efficient in land forming. This equipment could be used for the progressive development of the perimeter zone. This action would eliminate the need to 'hire' and would be most appreciated, in the expansion of feedlot operations, as well as handling the day to day waste disposal.

After land forming is completed, trees should be installed, followed by the planting of grass ground covers. The development of the perimeter 'buffer' zone should be planned around future expansion programs of the feedlot operation. If expansion is contemplated, land forming and plantings should occur in the permanent location of the perimeter zone, to eliminate the need for relocation, Figure 46.

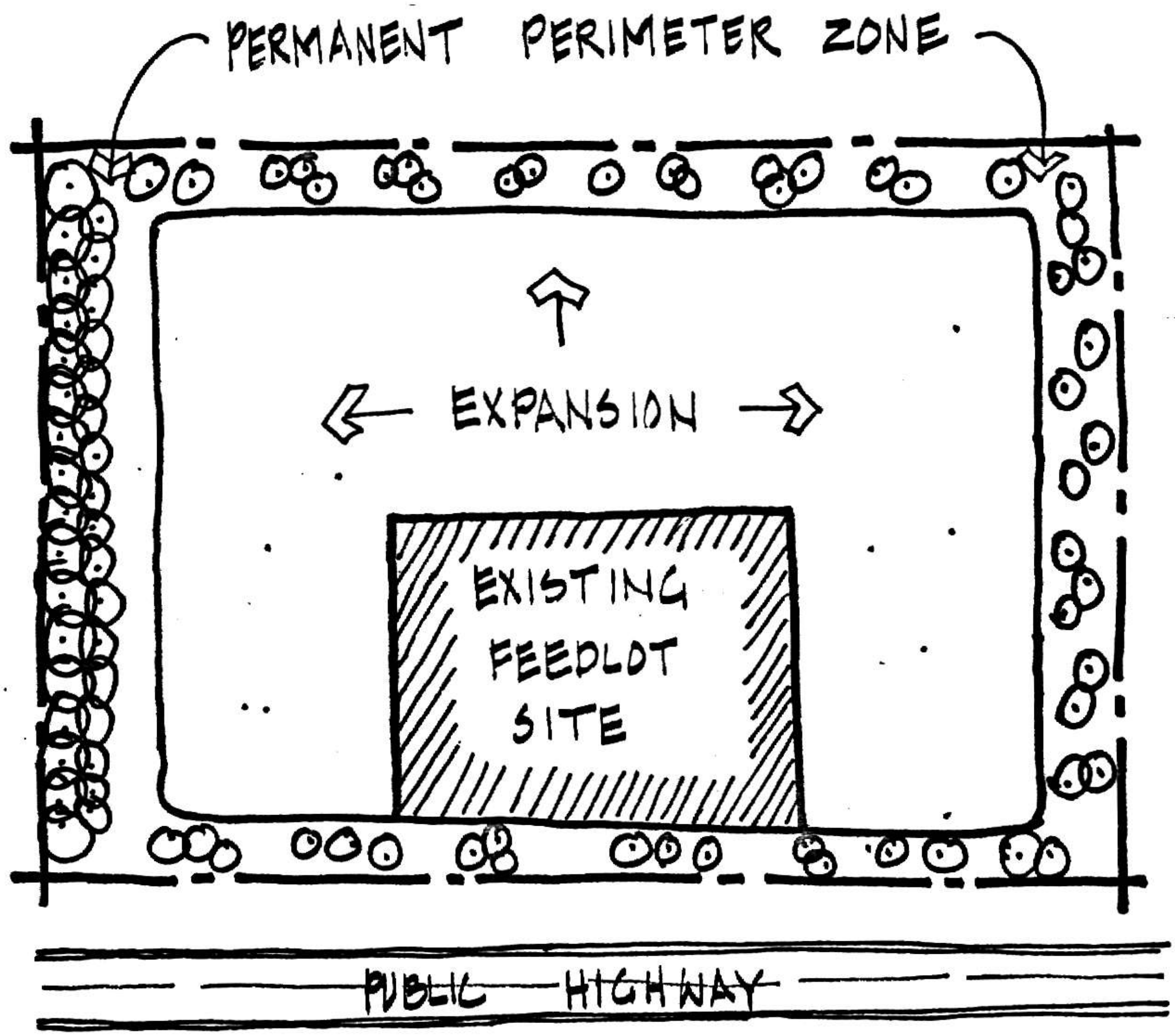


Figure 46. Perimeter 'buffer' Zone and Expansion.

Site Setback Distance Concepts

In some areas, minimum site setback distances from existing arterial highways, residential dwellings and municipalities, have been established, as pointed out in Chapter 5. Feedlot site setbacks should be considered to minimize environmental pollution (nuisance) problems.

Two approaches to site setbacks are: 1) limited setback; and 2) unlimited distance setback.

Limited Distance Setback

The limited distance setback concept involves the development of the perimeter 'buffer' zone, directly adjacent to the public road. The extreme, outer boundary, of the perimeter zone, is directly on the public road, right-of-way line, Figure 47. The perimeter zone development serves as the site setback, which should be a minimum of 100 feet.

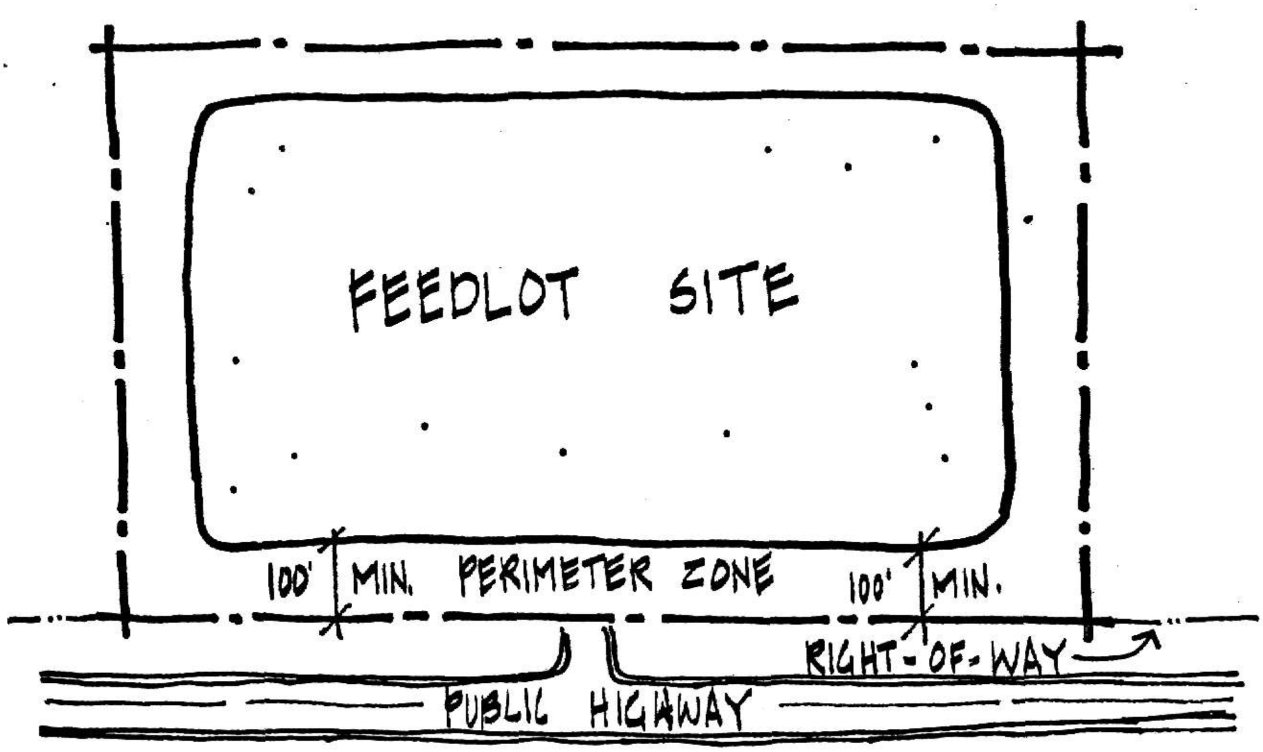


Figure 47. Limited Site Setback Distance.

Unlimited Distance Setback

The unlimited destance setback concept involves distances in excess of 100 feet, from the public road, right-of-way, to the outer boundary of the perimeter zone, Figure 48. This concept utilizes the principle of; "the greater the distance between the feedlot site and public roads, the lesser the probability of environmental nuisances and resulting court actions".

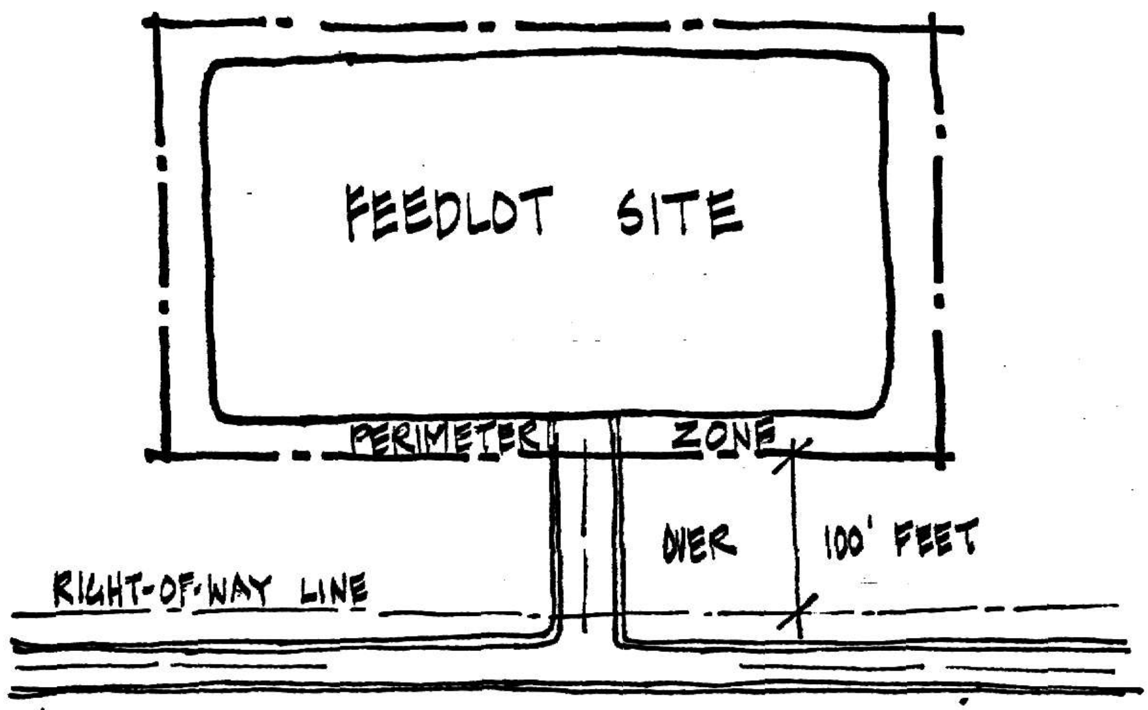


Figure 48. Unlimited Site Setback Distance.

If this concept of setback is used, the area between the public road, right-of-way and the feedlot perimeter 'buffer' zone should be utilized for feed crop production, such as corn, milo, alfalfa and wheat, to serve as an additional 'buffer' area. This concept requirs the development of a longer access road to the feedlot site, which will be illustrated in a later section of this text.

Site Entrance Development

The main entrance, of the commercial feedlot site, is extremely important to the functional efficiency and public image of the feedlot operation. Therefore, the entrance areas should be developed for easy access, traffic safety and aesthetic quality.

The primary function, of the entrance area, is to accommodate vehicular traffic. Since large, truck traffic is essential and generally of high volume, to and from the commercial feedlot, entrance road widths, turning radii, sight lines and road surfaces must be designed to accommodate the largest of truck vehicles, the semi-trailer truck, or '18 wheelers'.

For the entrance area to function properly, in the role of public relations and traffic safety, the following design criteria is suggested for development.

Design Criteria

Although a commercial feedlot should be located in an area that is served by major, arterial highways, site entrances should be limited to good, secondary, public roads, where traffic volumes and vehicular speeds have been reduced, Figure 49.

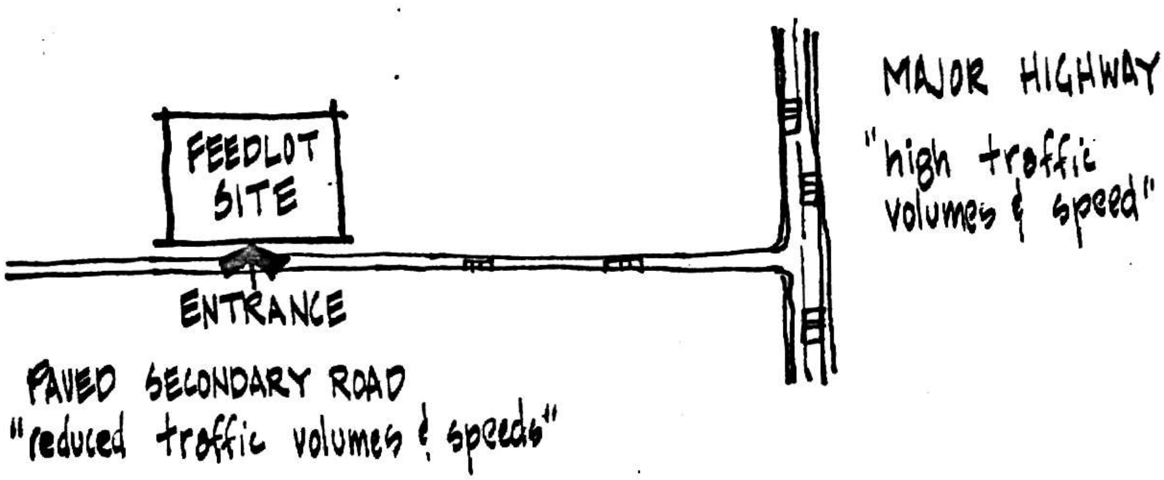


Figure 49. Site Entrance on Secondary Road.

Due to the slow starting and stopping capabilities of large, transport trucks, acceleration and deceleration lanes should be provided to enable these trucks to merge safely with moveing traffic, Figure 50. The mergence lanes should be approximately 200 feet in length, with a minimum width of 12 to 15 feet. The surface should be paved, to permit all-weather usage, and to handle heavy loads, such as cattle and feed grains. (54)

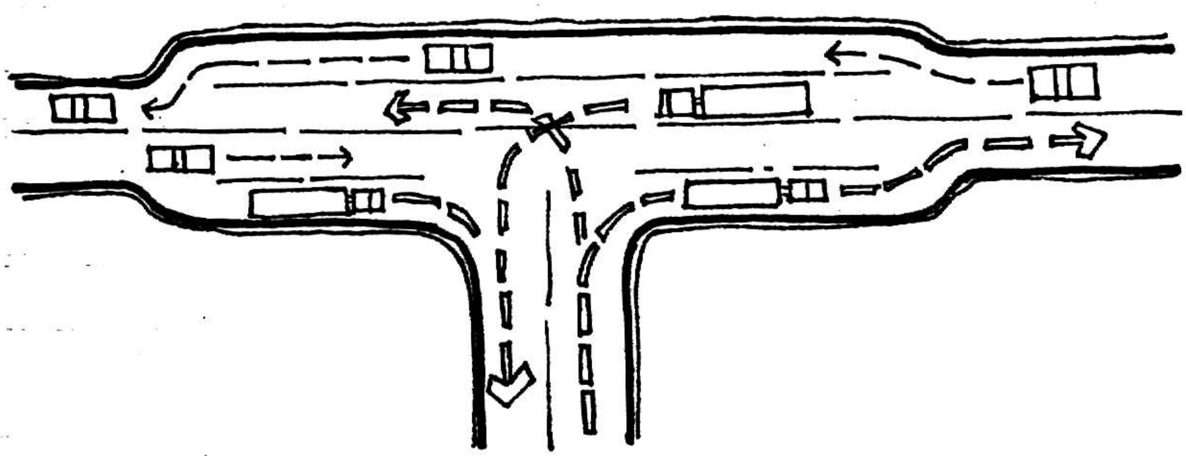


Figure 50. Acceleration and Deceleration Lanes.

Site entrances should be avoided on hills or steep grades of over 7 per cent gradient, as such grades can create manueverability and safety problems. Site entrances should not occur within 150 feet of existing intersection, railroad crossings, bridges or curves on public roads, Figure 51. (54)

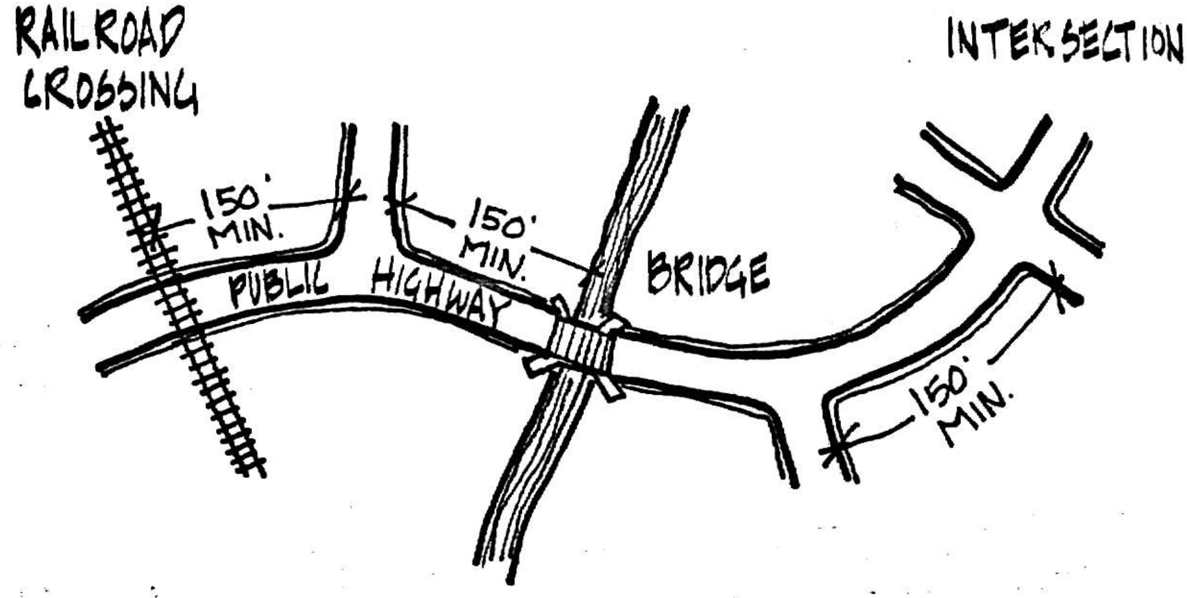


Figure 51. Location of Site Entrances.

Adequate sight distances should be provide for all vehicles entering and leaving the feedlot site, Figure 52. Plantings and/or land forms, in excess of 3 feet in height, should not be used in this area. (52)

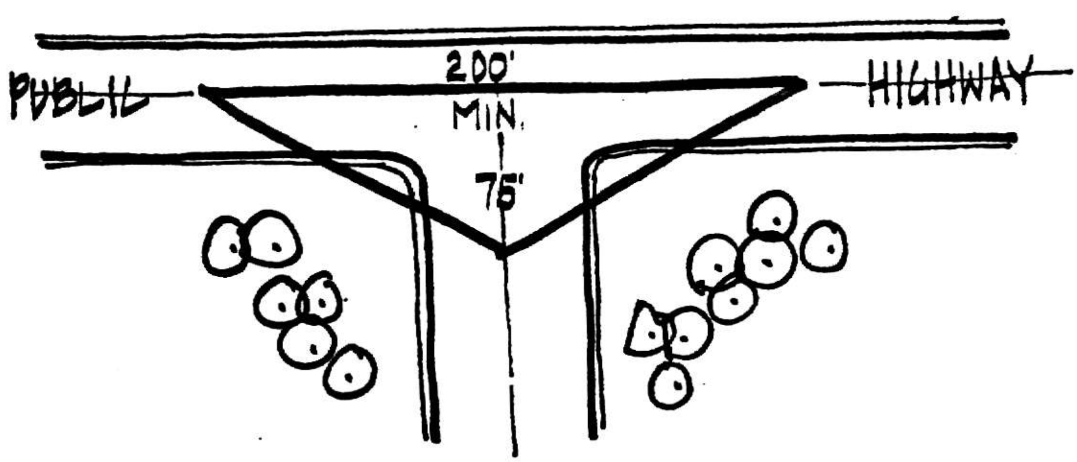


Figure 52. Sight Distances at Entrance.

Site entrance roads should intersect public roads, at a 90 degree angle, to permit maximum sight distances and provide negotiable turning radii, Figure 53. The minimum turning radius, for large, transport trucks, is 40 feet. (54)

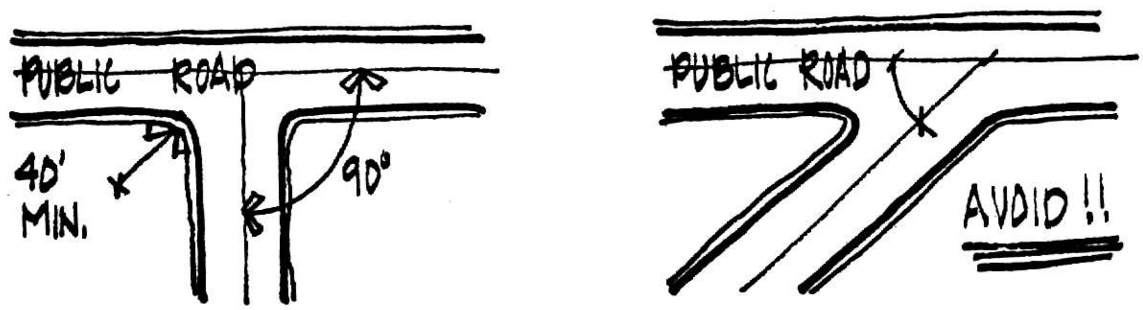


Figure 53. Site Entrances and Intersections.

The site entrance area should be well-defined, with curbing, plant materials and land forming, to effectively contain and direct traffic flow, Figure 54. A minimum width of 30 feet is recommended, to permit two-way, truck traffic. (52)

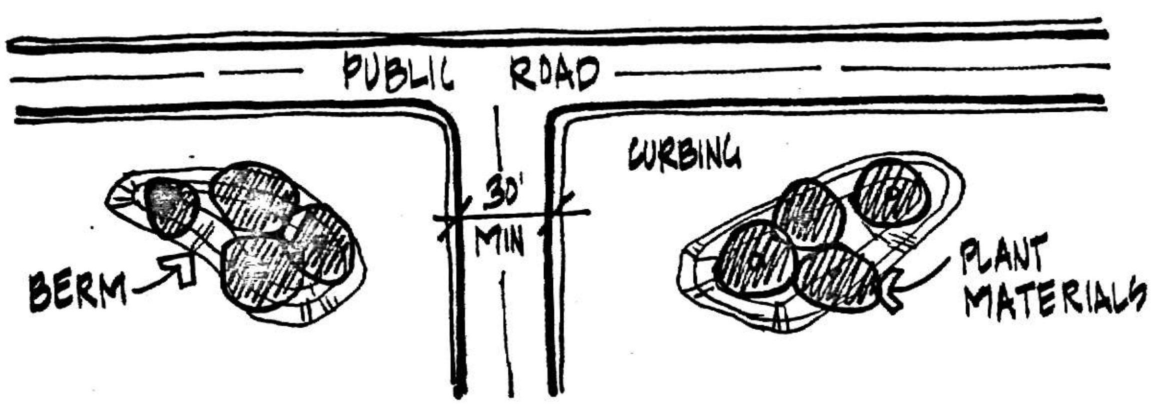


Figure 54. Spatial Definition of Site Entrance.

The entrance road intersection, with the public highway, should not have a slope gradient, in excess of 5 per cent, for a distance of at least 100 feet, to permit large trucks to stop and start safely, Figure 55. (54)

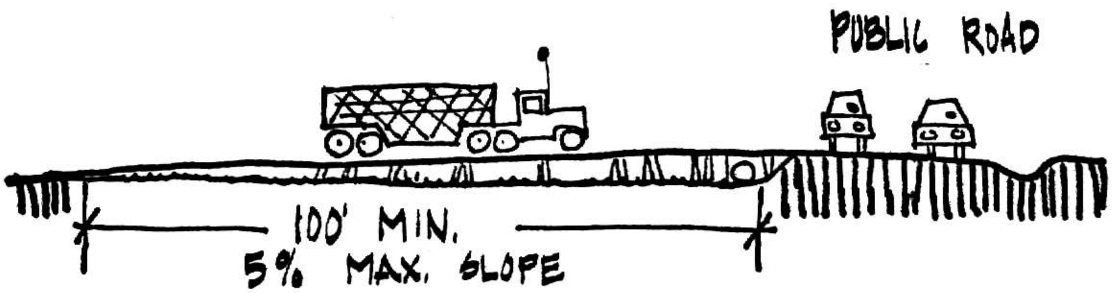


Figure 55. Site Entrance Road Gradient.

Shake screens, embedded in the exit lane of the entrance road, should be provided to collect mud, debris and manure, from being carried from the site, via truck tires, frames and transport beds, Figure 56, (52) It is interesting to note, that in the early days of the Ohio Valley cattle feeder, manure was hauled from the feedlot, and dumped into the public road, as a method of disposal. This method is unpractical and illegal today.

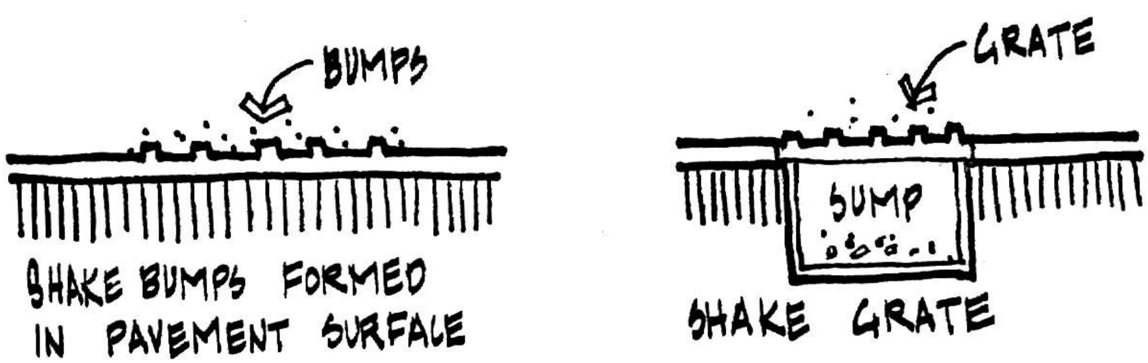


Figure 56. Shake Screens in Entrance Roads.

To eliminate sight line views, directly into the feedlot site, a curved entrance road should be developed, Figure 57. (54) Curved entrance roads are more applicable to feedlot sites, with the unlimited setback distance, mentioned earlier. If a curved entrance road is used, the curve should not extend any closer than 100 feet to the intersection of the public road. (54) This distance will enable traffic to become perpendicular with the road, before turning.

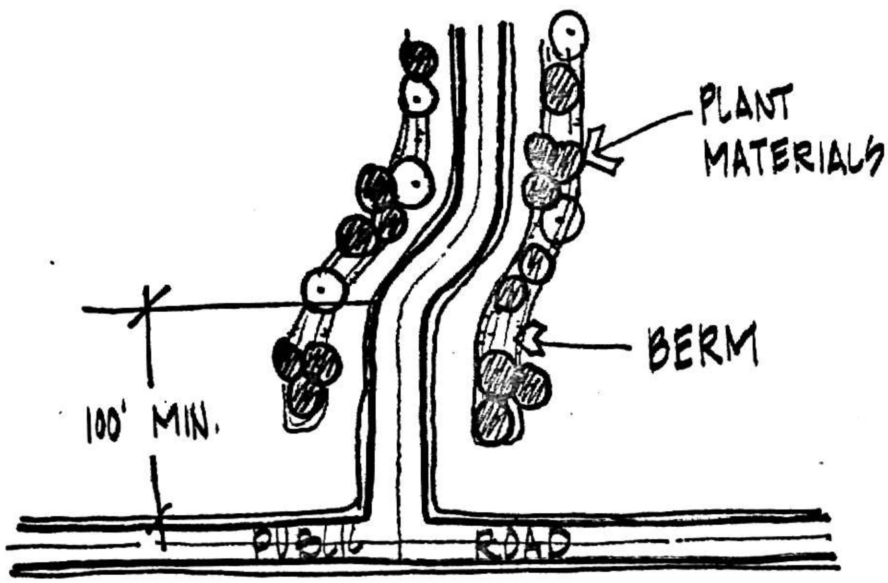


Figure 57. Curved Site Entrance Road.

Along with the entry road, the entire entrance area into the feedlot site, should be carefully planned. This area is usually remembered as the first impression of the operation. For this reason, attention should be given to attractive landscape forms. Land forming and plant materials can be used effectively, to re-inforce this space and create visual quality.

DEVELOPMENT GUIDELINES FOR THE PRIVATE COMPONENTS

The private or operational components of the commercial feedlot, although differing from the public components, must be developed to improve the visual quality and public image of the total operation. Each component of the operational center must be considered individually, and collectively in site development. The individual private components are: the feed mill, office, roughage storage, cattle shipping and receiving and equipment maintenance/storage areas.

These components can be organized in various ways, without seriously affecting the efficiency of the overall operation. However, according to Gill and Paine (44), these components should be compactly grouped, near the access road and the center of the feedlot site, for the most efficient operation, Figure 59.

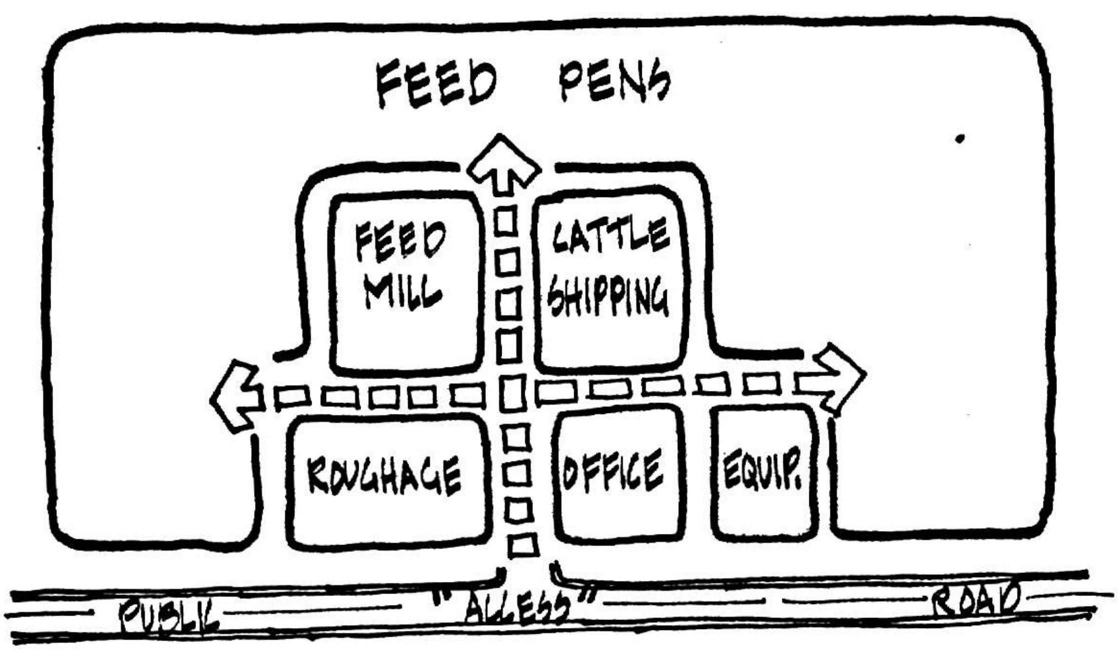


Figure 59. Private or Operational Components.

Spatial requirements for the operational center of the feedlot are approximately 15 to 20 percent of the total feedlot site. A 10,000 head capacity feedlot, with 100 acres of total area, will require between 15 and 20 acres, for the operational center. Individual component acreages are:

Feed mill	2
Roughage storage	4
Cattle shipping and receiving	3
Equipment maintenance and storage	2
Administration office and weigh scales	2
Interior site roads	2
Total Acreage	15

The operational center of the commercial feedlot is a combination of different land uses, each contributing to traffic flow and nuisance problems of noise, dust and objectionable, visual appearance. Consequently, the operational center can be responsible for some public criticism. Unfavorable attention is especially attracted, if the appearance of the operational center is disorganized and in a state of disrepair.

The operational center is the identifying feature, or focal point, of most commercial feedlot operations. It's visual appearance is based upon such factors as; relationship to the surrounding environment, visual exposure, structural character and site upkeep. The first step toward presenting a favorable public image, associated with the operational center, is to select the best possible location for the facilities. The location should satisfy the functional requirements of close proximity and vehicular access. The ideal location, for the operational center, is in an area secluded by vegetative and topographic screening, while meeting functional requirements.

Since the majority of feedlot sites do not meet the ideal location requirements, an environment should be developed that encompasses nuisance controlling features. The most efficient way to accomplish this objective is by the development of the interior site, utilizing plant materials and land forms to: 1) confine and reduce dust and odor; 2) baffle and absorb noise; and 3) screen from view, objectionable features of the operation.

Earth berms, up to 5 feet in height, should be developed around each individual component, to serve as visual screens and spatial definition, Figure 60. Berms should, however, be located out of the way of active, operating areas.

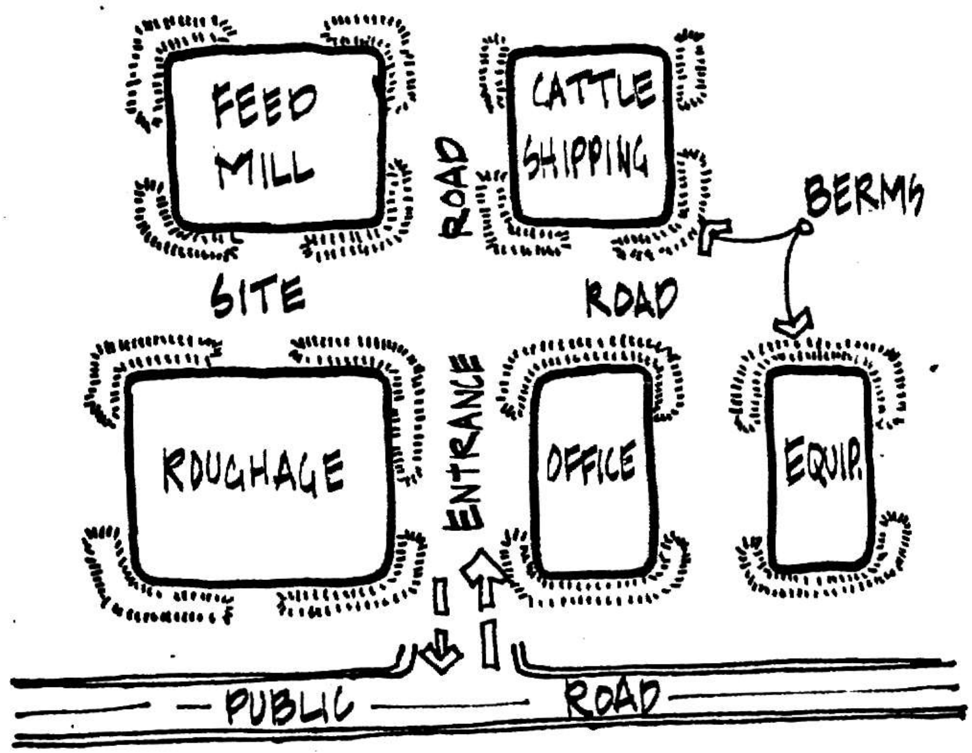


Figure 60. Spatial Definition of Private Components with Berms.

Berm slopes should be a maximum of 3 to 1, for maintenance purposes. Slopes should be seeded with ground covers such as; brome, fescue and crown vetch to prevent erosion, absorb noise, dust and to improve the visual appearance of the interior site.

Base widths, of the berms, should be between 25 and 30 feet, to minimize spatial requirements. It was noticed, during the field trips, that most commercial feedlot operations have adequate space, within the interior site, to permit such berm development, without additional land area. Therefore, the 10 acres per 1,000 head of capacity land requirement, remains applicable.

To achieve maximum spatial definition, trees, such as; russian olive, redbud, austrian pine, honeylocust and hackberry should be planted on the berm slopes, Figure 61. Berm development, within the interior site, will

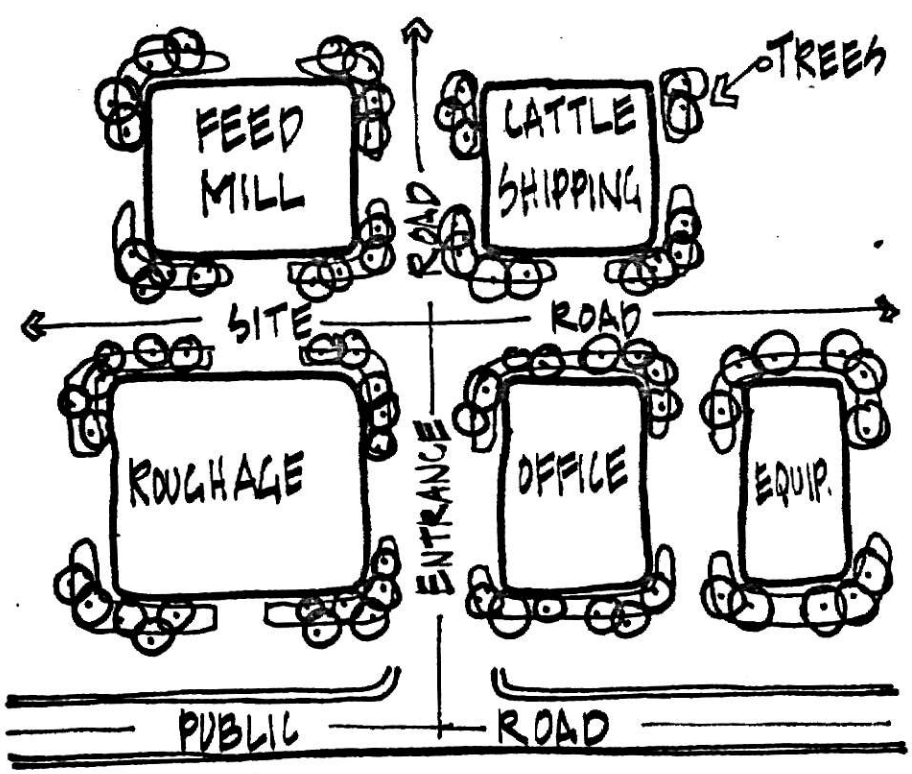


Figure 61. Spatial Definition of Private Components with Plant Materials.

serve to control traffic circulation, reduce wind velocities in work areas, minimize atomspheric nuisances and improve the overall visual appearance of the feedlot operation, Figure 62.

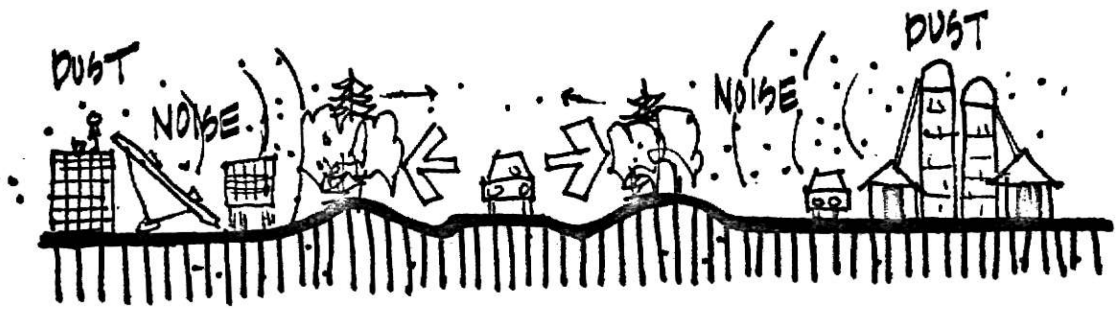


Figure 62. Interior Site Plantings to Absorb Atomspheric Pollution.

Interior site roads and spatial defining, berm development should be utilized to direct runoff drainage from the operational center of the feedlot, Figure 63. Each operational component area should be graded to provide positive drainage, 2 to 4 per cent, away from the middle of the work area. Specific feedlot sites will present individual drainage problems, however, this concept gives an indication of desired drainage patterns.

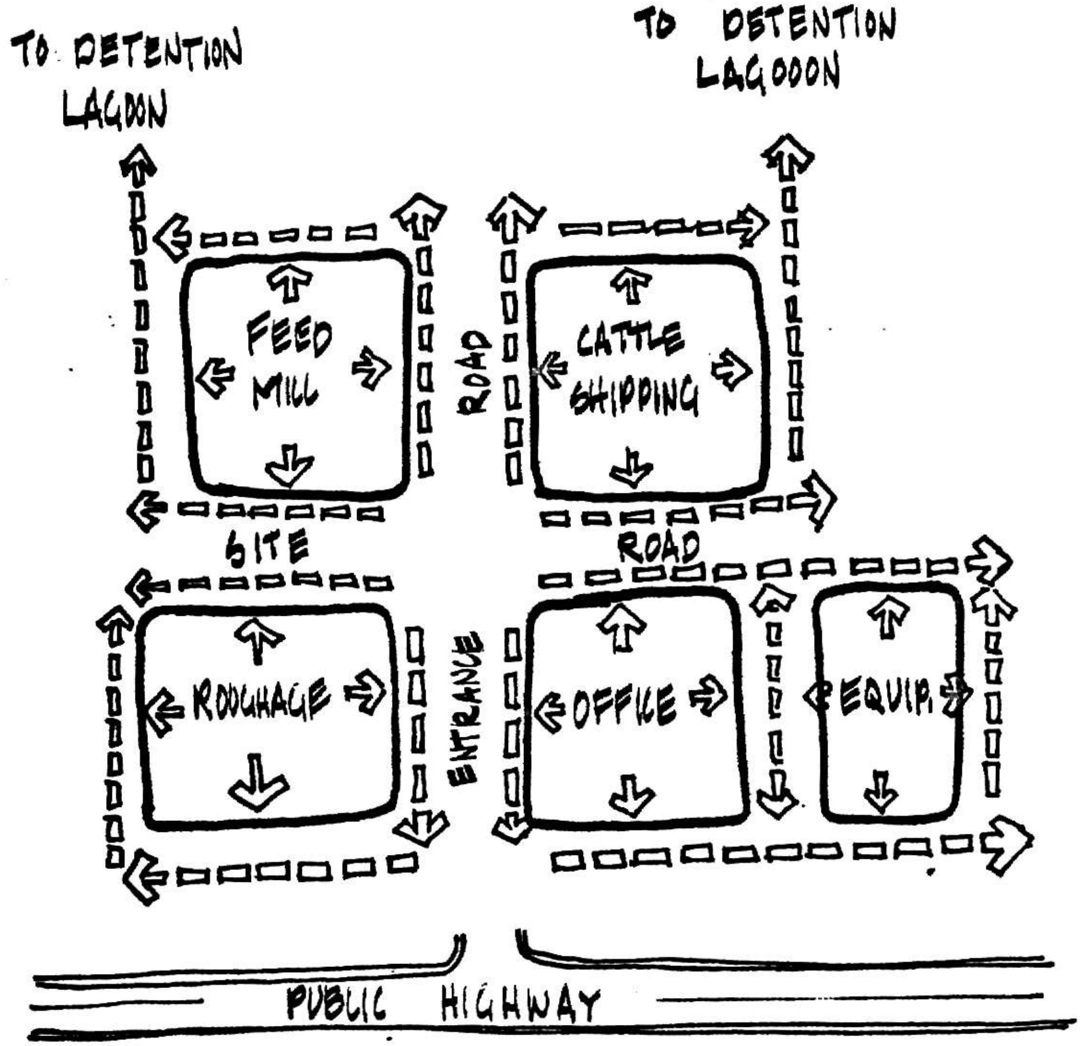


Figure 63. Drainage Patterns of Private Components.

Administration Area

The center of business activity, for a commercial feedlot operation, is the administration or office area. Although the administration area is basic to the operational components, it is considered public, as visitors, salesmen, feed company representatives, cattle buyers and employees alike, all use this area on a daily basis. Therefore, development of the administration area should contribute to traffic circulation, public safety and visual quality.

The administration area should be near the site entrance road and clearly visible, to eliminate any confusion as to its location, Figure 64. As it

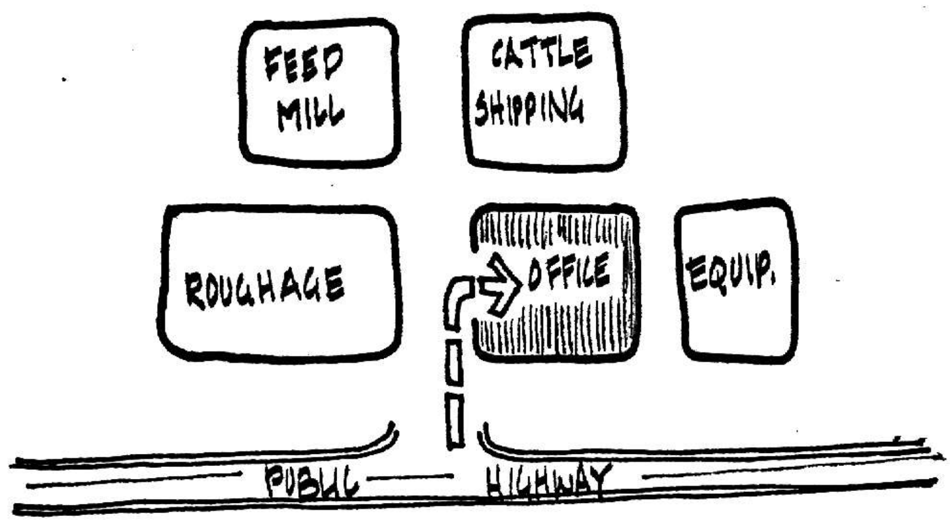


Figure 64. Administration Area.

is common practice to incorporate weight scales near the office area, large transport truck traffic should be routed to the administration area, Figure 65. The weight scales should be directly accessible from the site entrance road. The area should be defined with plant materials and land forms to control and direct traffic circulation.

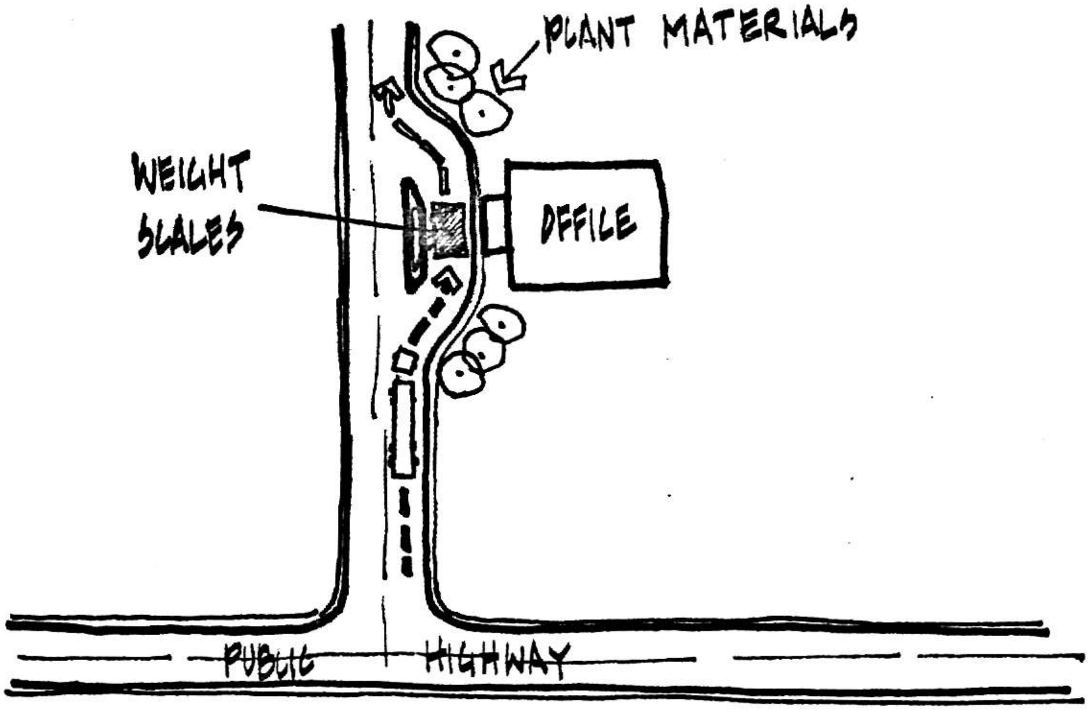


Figure 65. Administration Area with Weigh Scales and Traffic Flow.

A minimum of 10 parking spaces should be provided near the administration area, to accommodate visitor and staff vehicles. Parking requirements for feedlot operations are approximately 2.5 spaces per 1,000 head of feedlot capacity. (44) The location of the parking should not interfere with the daily operational traffic circulation, Figure 66. To reduce the visual

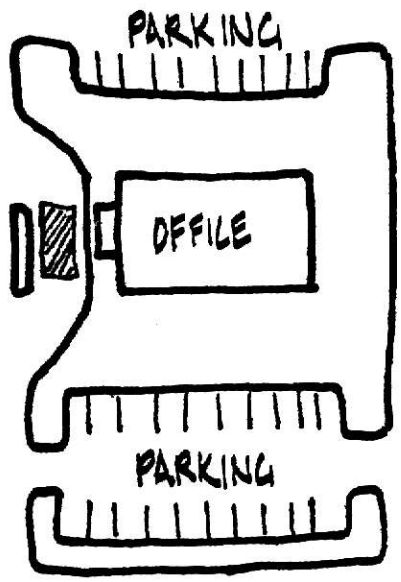


Figure 66. Parking within the Administration Area.

impact of large, parking areas, land forms and plant materials should be incorporated, to screen and define the area, Figure 67.

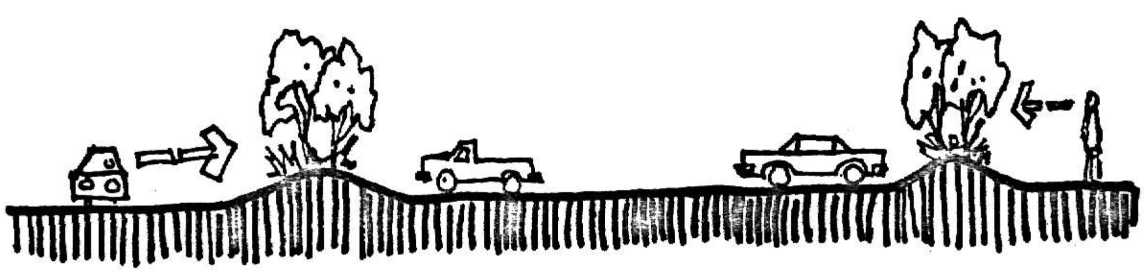


Figure 67. Screening of Parking Area.

The administration area should be developed to provide both functional and visual quality. According to Dyer & O'Mary (7), attractive site arrangements and appearance appeal to customers and employees alike. These factors can contribute to confidence in management and pride in employees. The end result is often the best sales tool that a feedlot has. (7) For this reason, landscaping, paved walkways, view stations and grass areas should be developed into the design of the administration area, Figure 68.

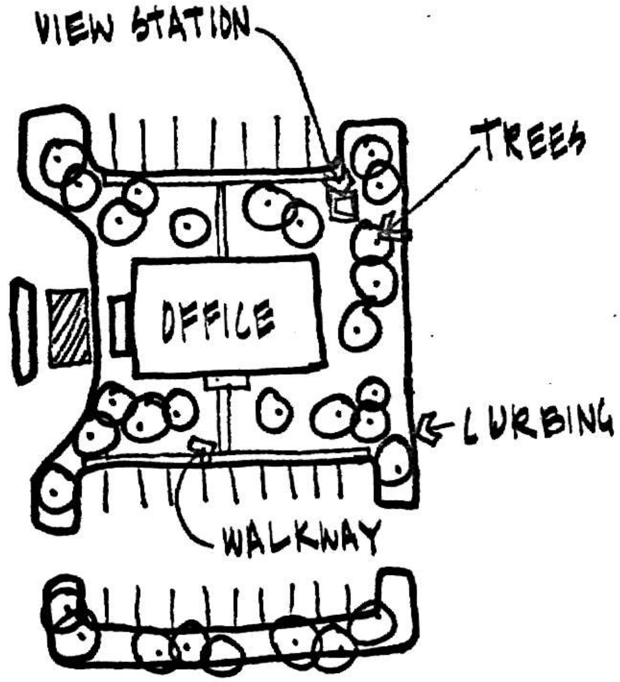


Figure 68. Administration Area Development.

Feed Mill Area

The location and layout of the feed mill structure should receive careful consideration, as it is the most active, operational component in the feedlot operation. If a railroad siding is available, the feed mill should be located near it, and therefore restricted. However, in the absence of rail service, the feed mill location must provide vehicular access from the public road, through the weight scales at the administration area, to record incoming feed shipments and adjacent to feeding pen areas, Figure 69. (7) The feed mill should be centrally located on the site, and on higher elevations, to enable heavily loaded feed trucks, to descend slopes loaded and return to the feed mill empty. (7)

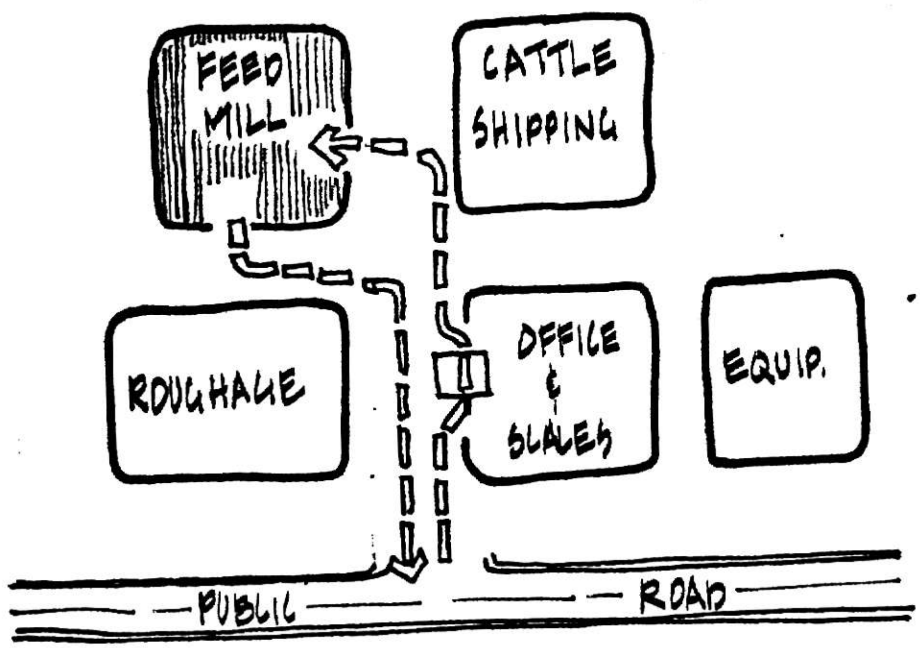


Figure 69. Feed Mill Area.

Since truck traffic is excessive, around the feed mill, the layout should allow for feed ingredients to be received, at the same time that finished feed rations are shipped out, Figure 70. Provisions for expansion should also be considered.

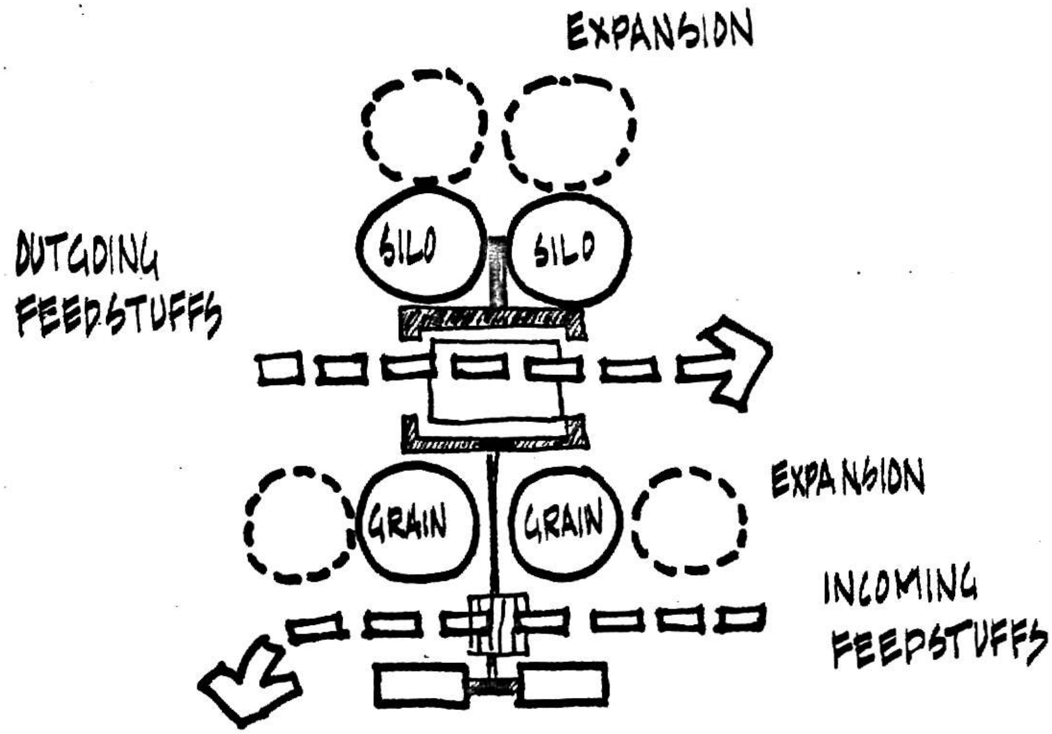


Figure 70. Feed Mill Structure.

Due to the size and vertical height of feed mill structures, they tend to become the focal point of the feedlot operation. Therefore, consideration should be given to the surrounding work area. The slope of the area should be uniformly graded, at 2 to 4 per cent away from structures, to provide positive drainage and vehicular manueverability. To direct and control vehicular circulation, curbing should be introduced, Figure 71. The exact formation of curbing will depend upon traffic circulation patterns and parking areas. Spaces that are enclosed, by curbing, should be used for the installation of plant materials, to improve the feed mill's visual appearance.

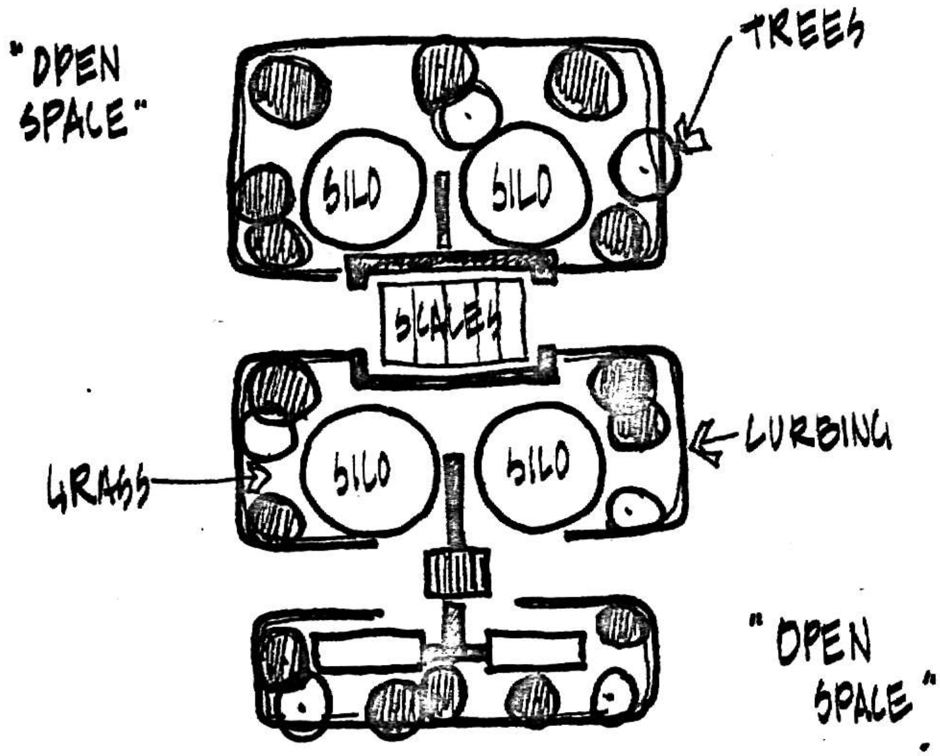


Figure 71. Feed Mill Area Development.

Plant materials, around the feed mill, serve several functions: 1) absorption and reduction of noise and dust levels, generated by the feed mill operation, Figure 72. Noise levels, in this area, can approach 80 to 100 decibels and should be reduced as much as possible.

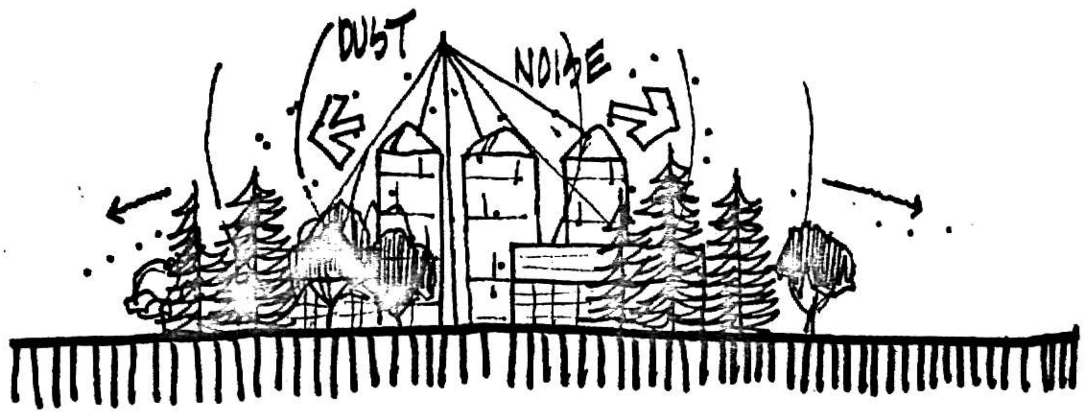


Figure 72. Feed Mill Plantings to Absorb Atomspheric Pollution.

2) modification of the horizontal and vertical scale of large, feed mill structures, for improved visual appearance, Figure 73.

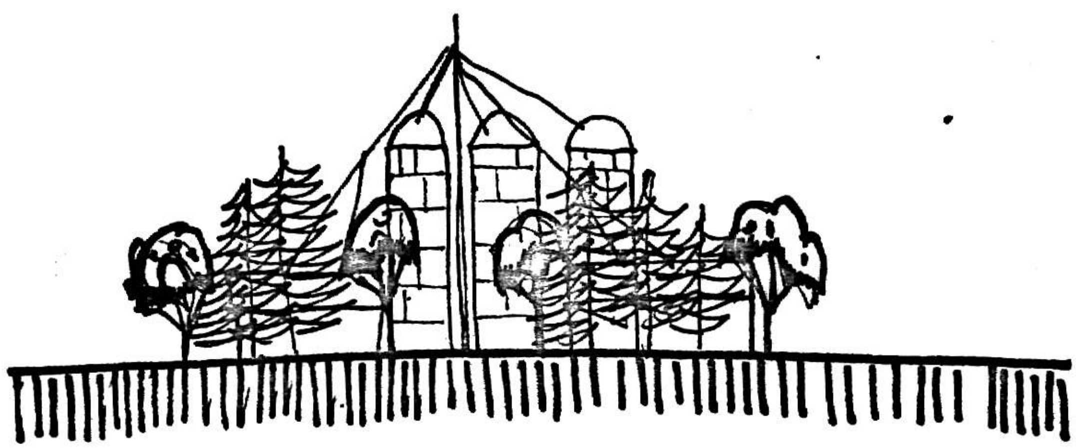


Figure 73. Feed Mill Plantings for Scale Modification of Structures.

3) reduction of wind velocities around the feed mill structures, to prevent swirling wind currents, which can cause dust and feed ration losses. Research has shown that large, vertical structures, such as feed mills, can increase wind velocities, by as much as 30 per cent, for short distances. Therefore, this wind speed should be reduced as much as possible, by baffling with plant materials.

The selection of plant materials, near the base of the feed mill structure, should be limited to large, evergreen trees, such as austrian pine and red cedar. Medium size trees, such as russian olive and redbud can also be used. Trees with large spreading canopies, such as elm and hackberry, should be used only if adequate space is available, to prevent branches from coming into contact with the feed mill structures. Large, evergreen trees and medium size trees can be located in limited space areas, due to smaller branching patterns. The use of these trees will provide year around foliage, for noise and dust control, as well as year around color contrast.

The use of low, growing shrubs should be avoided near the feed mill, as they tend to provide harboring places for small rodents. Grasses can be installed, to provide a ground cover, but should be closely mowed to prevent rodent problems. Grasses will also help to reduce noise and dust conditions.

The areas of the feed mill, outside of curb defined spaces, must be kept open and unobstructed for vehicular movement. Therefore, additional plant materials should not be introduced in this area, Figure 71.

Roughage Feed Storage Area

The roughage feed storage area is utilized to store and stockpile forage crops, such as alfalfa, corn silage and hay, to await later use in prepared feed rations for cattle in the feedlot operation. Roughage feed storage operations involve the transportation of hay and forage crops from surrounding crop fields, to the storage area, by way of large trucks and equipment. Therefore, vehicular access, from the public road and adjacent crop fields, must be provided, Figure 74. Vehicular access must also be provided, from the roughage storage area to the feed mill, as roughage feeds are moved, to the feed mill, as needed for feed ration preparation. The roughage feed storage area should be located adjacent to the feed mill, to minimize hauling distances and traffic congestion.

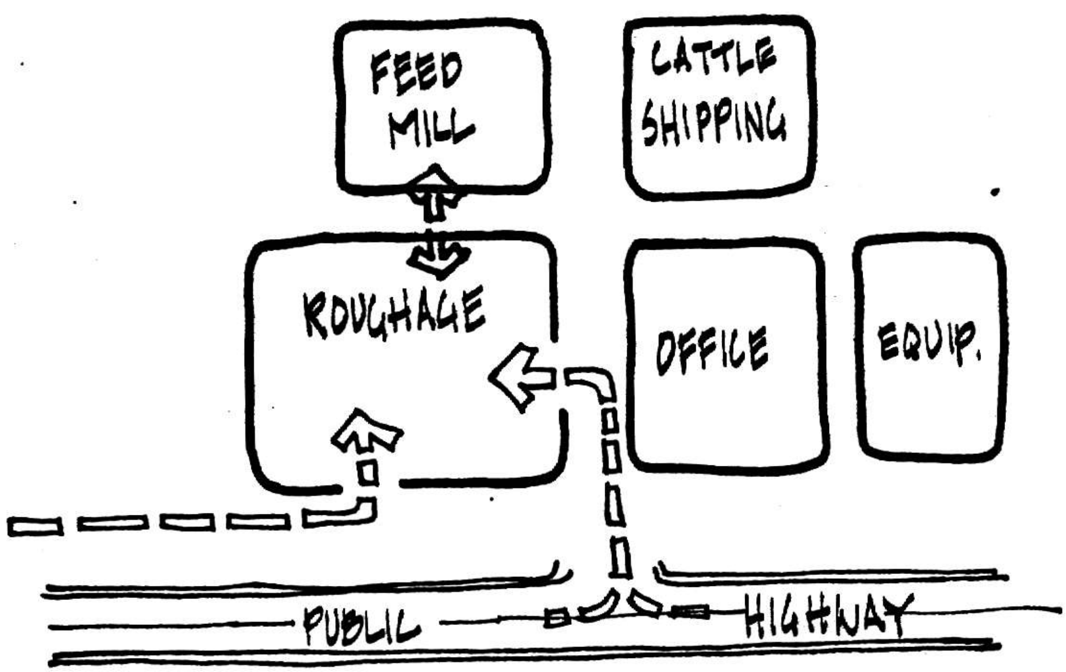


Figure 74. Roughage Feed Storage Area.

The interior of the roughage feed storage area must be kept open and unobstructed, to allow vehicular equipment operation around pit silos and haystacks, Figure 75. As pointed out earlier, in this Chapter, the roughage storage area should be spatially defined, with berms and plant materials, to direct traffic and serve as visual screening.

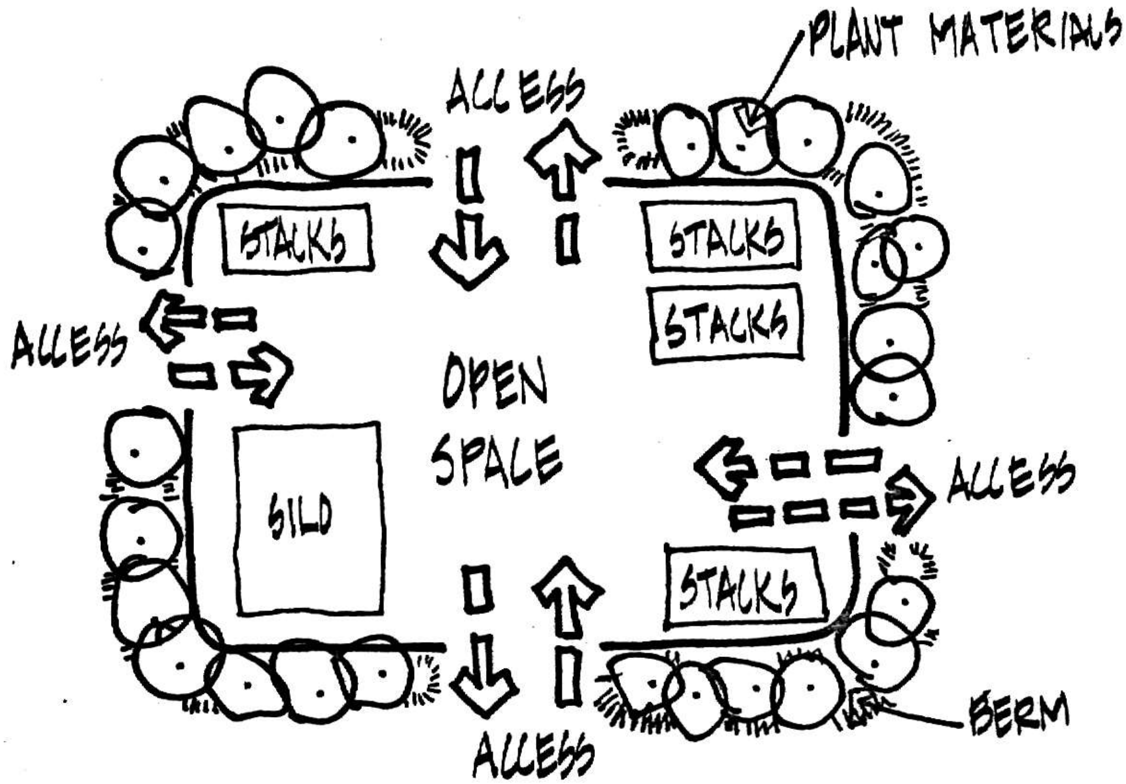


Figure 75. Roughage Feed Storage Area Structure.

Cattle Shipping and Receiving Area

The cattle shipping and receiving facility is a horizontal structure of confinement pens (corral), with loading platforms, used to ship and receive cattle. This facility is also used frequently for such operations as dehorning, dipping and branding of livestock, prior to feed pen confinement. Animal health care is also administrated in this area.

This facility should be centrally located, within the feedlot site, to permit a smooth flow of incoming and outgoing transport trucks. Also cattle movement to and from feeding pens should be considered, Figure 76. Vehicular access should not interfere with other site traffic, which could cause traffic flow disruptions.

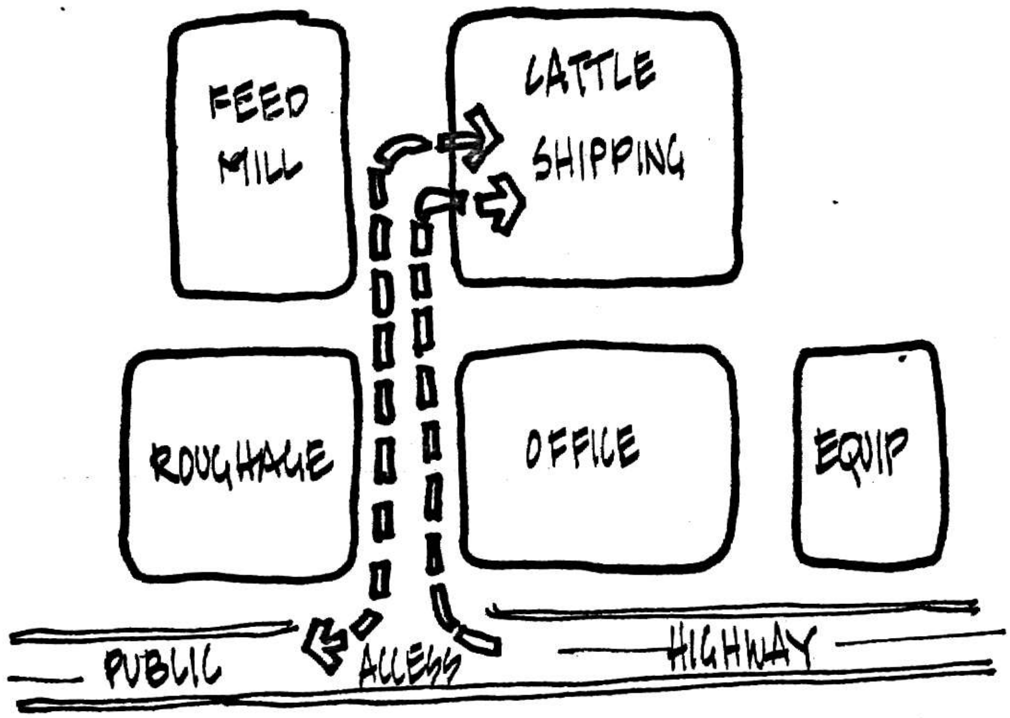


Figure 76. Cattle Shipping and Receiving Area.

The cattle shipping and receiving area should be located on gentle slopes, 2 to 4 per cent, to provide adequate pen drainage. The space directly in front of the facility should be relatively flat and unobstruced, for vehicular traffic, Figure 77.

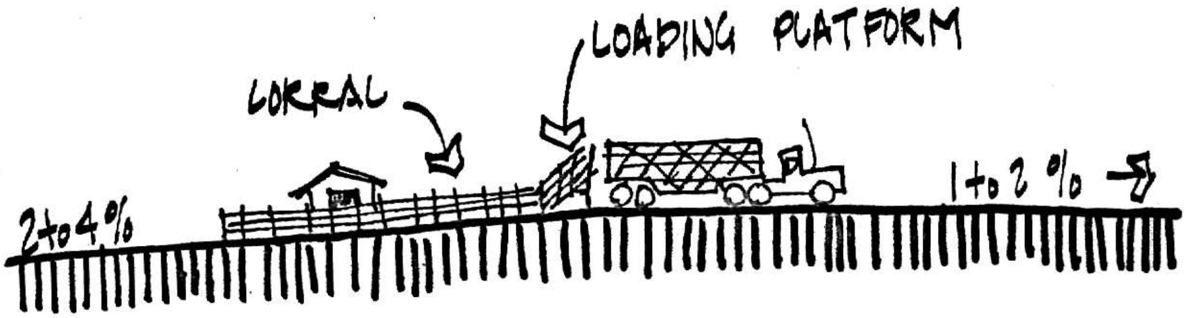


Figure 77. Drainage Pattern of Cattle Shipping and Receiving Area.

The rear of the facility should be kept open, to provide access to and from feed pen areas, Figure 78. Plant materials should be located around the area, to improve the visual appearance of the facility. However, densely spaced plantings are not desired, as air movement is needed to help reduce heat stress on livestock, during handling.

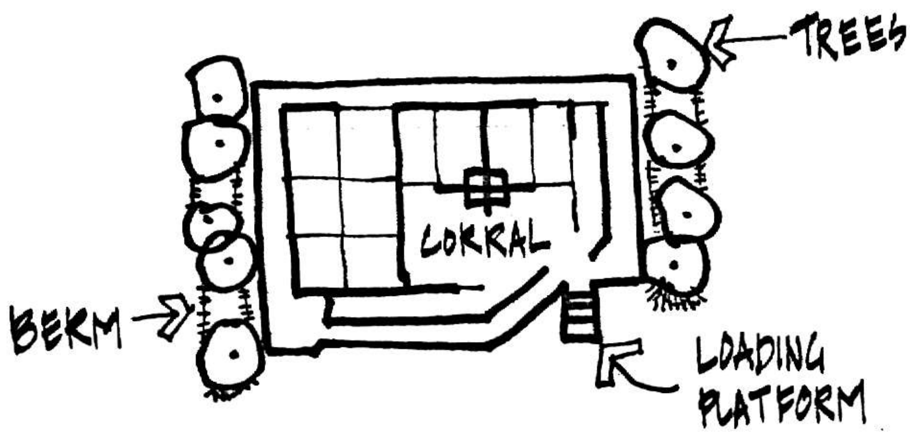


Figure 78. Cattle Shipping and Receiving Area Structure.

Equipment Maintenance and Storage Area

Vehicular equipment, utilized by the feedlot operation, represents a substantial financial investment. The feedlot's efficency depends upon good equipment, and therefore, maintenance and storage areas should be provided to keep equipment in good repair.

The equipment area should be near the operational center of the feedlot, for ready access to the other components, Figure 79. The facility should provide open space, for equipment storage, when not in use. A shop building should also be established and fully equipped, for repairs and maintenance operations.

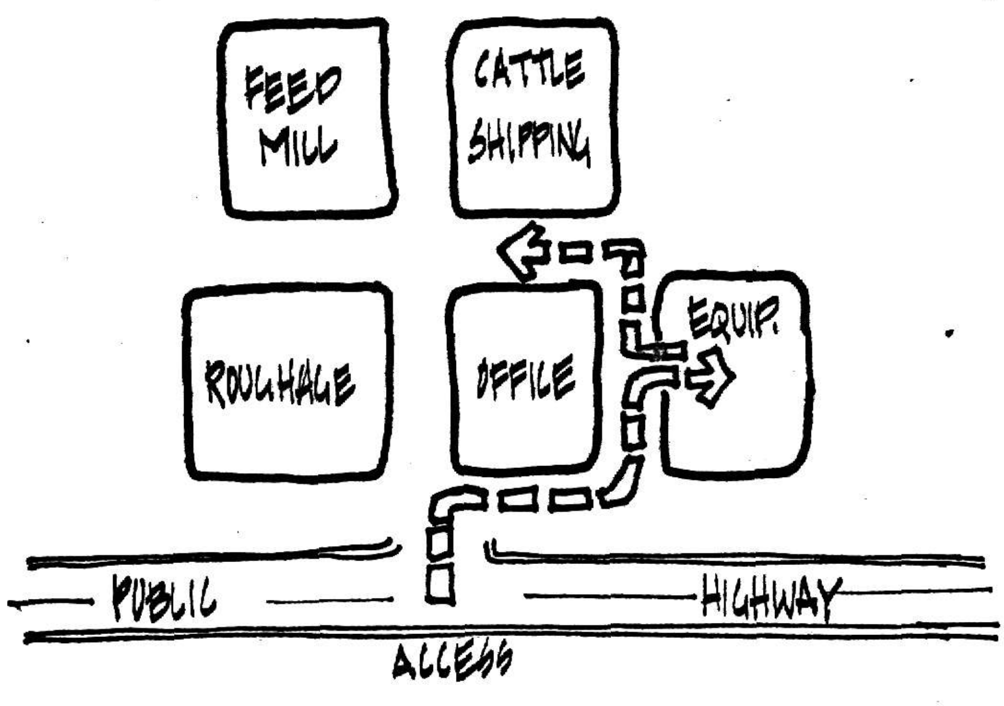


Figure 79. Equipment Maintenance and Storage Area.

The development of the equipment storage and maintenance area presents similar problems as the other operational components, in that the interior of the area must be kept open and unobstructed, to allow for equipment movement, Figure 80. Therefore, plant materials, within the area, must not interfere with traffic circulation. The entire area should be defined with berms and plant materials to provide visual screening. Large trees, such as austrian pine, honeylocust and cottonwood should be introduced near the shop building, to reduce the visual impact of the structure and to also provide shade in outside working areas.

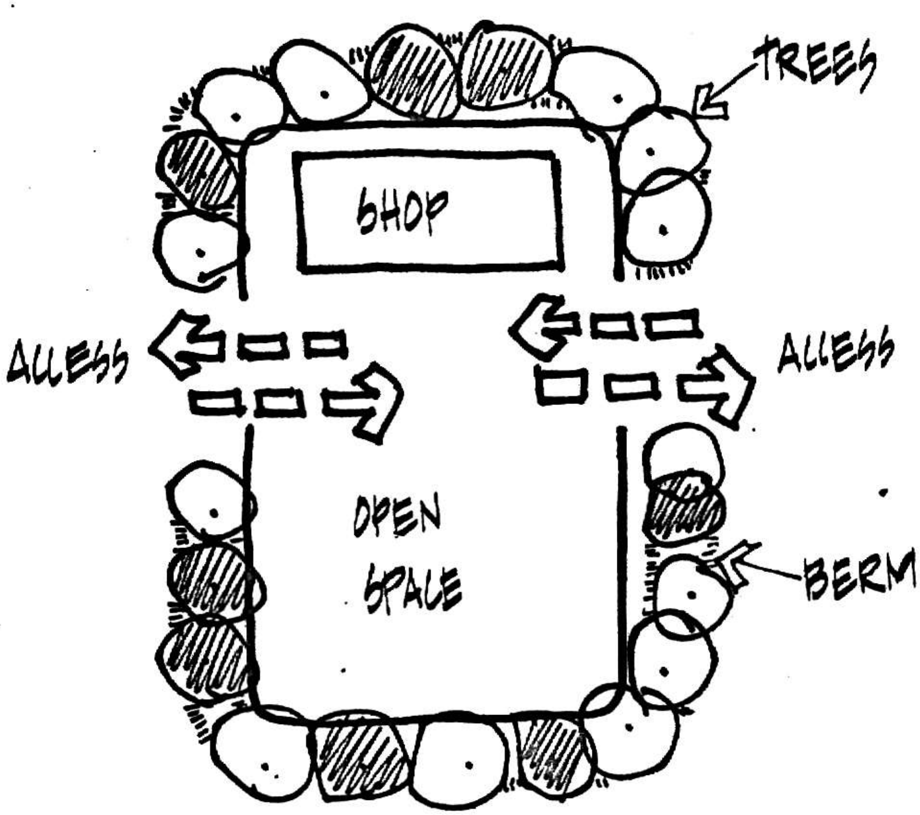


Figure 80. Equipment Maintenance and Storage Area Structure.

The types of equipment utilized by the commercial feedlot operation are shown in Figure 81. Equipment maintenance and storage areas, interior site roads and turning radii must be adequate to accommodate this equipment.

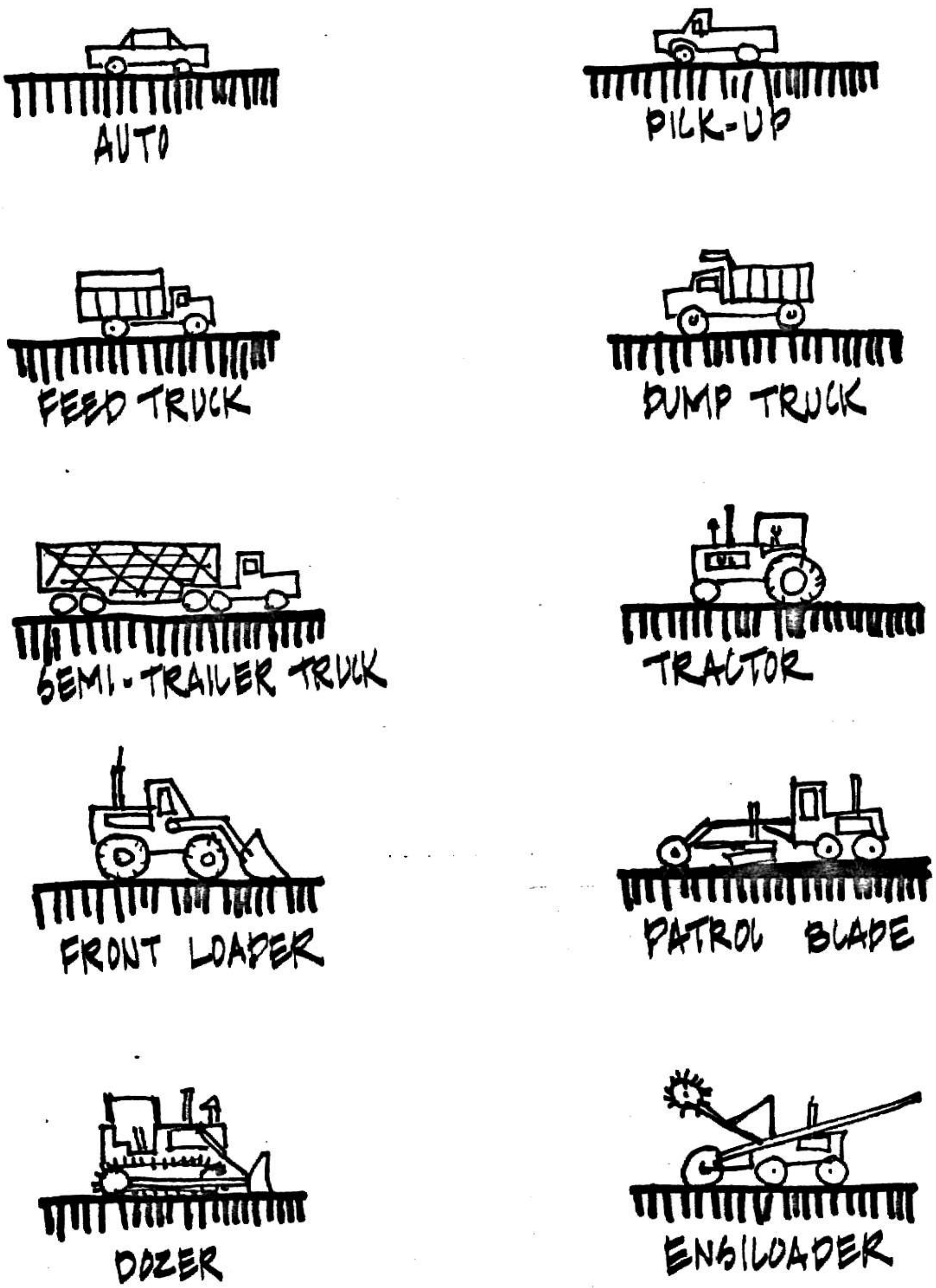


Figure 81. Equipment Types for Commercial Feedlot Operations.

Feeding Pen Area Design and Layout

Obviously, the planning of the commercial feedlot's feeding pens is critical. Feed pens compose the largest, single land use in the commercial feedlot site plan, Figure 82. Approximately 40 to 60 per cent of the total feedlot area is required for feed pen layout. This amounts to 4 to 6 acres per 1,000 head of capacity.

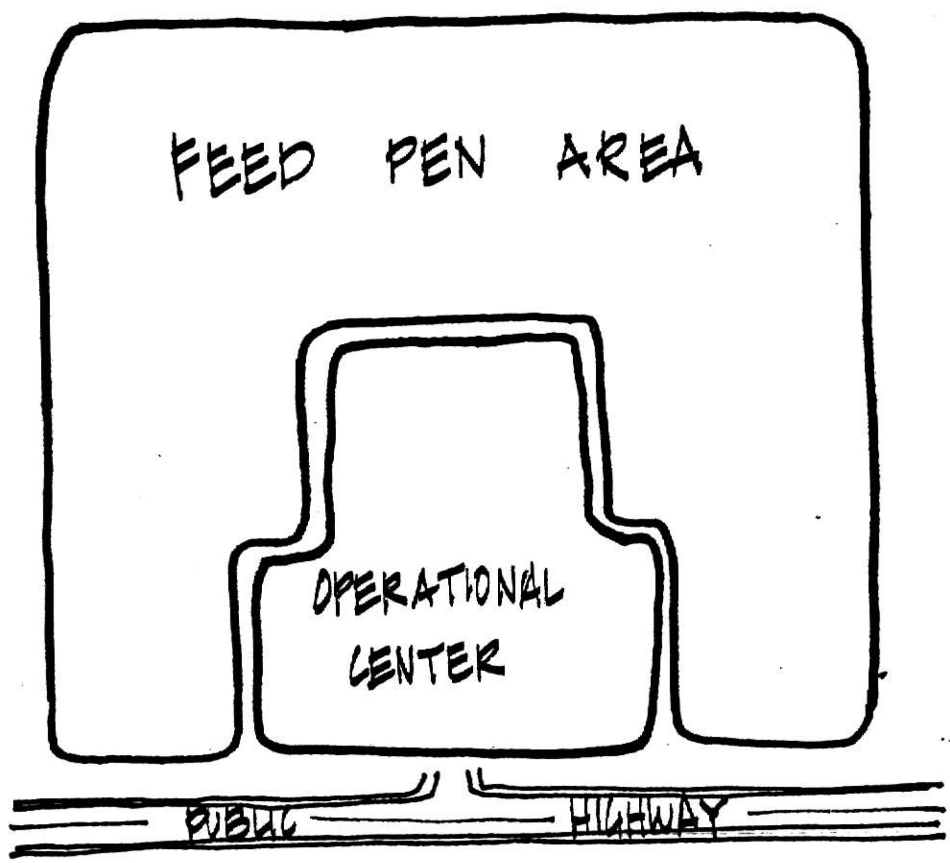


Figure 82. Feeding Pen Area.

Feed pen design and layout requires the consideration of several factors; climatic conditions, cattle densities, drainage runoff and traffic circulation patterns of livestock and equipment.

Climate

Climatic conditions can have a direct effect on feed pen design. A hot, dry climate requires a pen style that provides approximately 75 to 125 sq. ft. of pen space per head of capacity. A wet, humid climate may require 400 sq. ft. of pen space per head of capacity. The recommended pen space for moderately dry climates is approximately 125 to 200 sq. ft. per head of capacity. (7)

Cattle Density

High cattle densities can cause quagmire conditions in wet, humid pen areas, while excess pen space can cuase dust problems in dry climates. Pen capacities generally approach 150 to 300 head in most feedlots. An area 150 feet wide by 250 feet long is required to hold 150 head of livestock during the feeding process. This pen size allows for easier handling and closer supervision of the livestock. Most feedlots have pens of varying sizes to accommodate customer desires and changing climatic conditions. The smaller pens are generally located closer to the operational center, to reduce handling and feed cost. (7)

Drainage Runoff

Drainage of liquid runoff is the most important factor to consider in feed pen design and layout. Pens must be kept as dry as possible, without creating dust problems. Approximately a 25 to 30 percent moisture content, of the pen surface, is desired for optimum weight gains and non-dusty conditions, as well as odor control. (55)

Pen surfaces should be sloped, 2 to 6 percent, away from feed bunks and water stations, for adequate drainage, without erosion problems. (56) Figure 83 illustrates recommended methods of pen drainage.

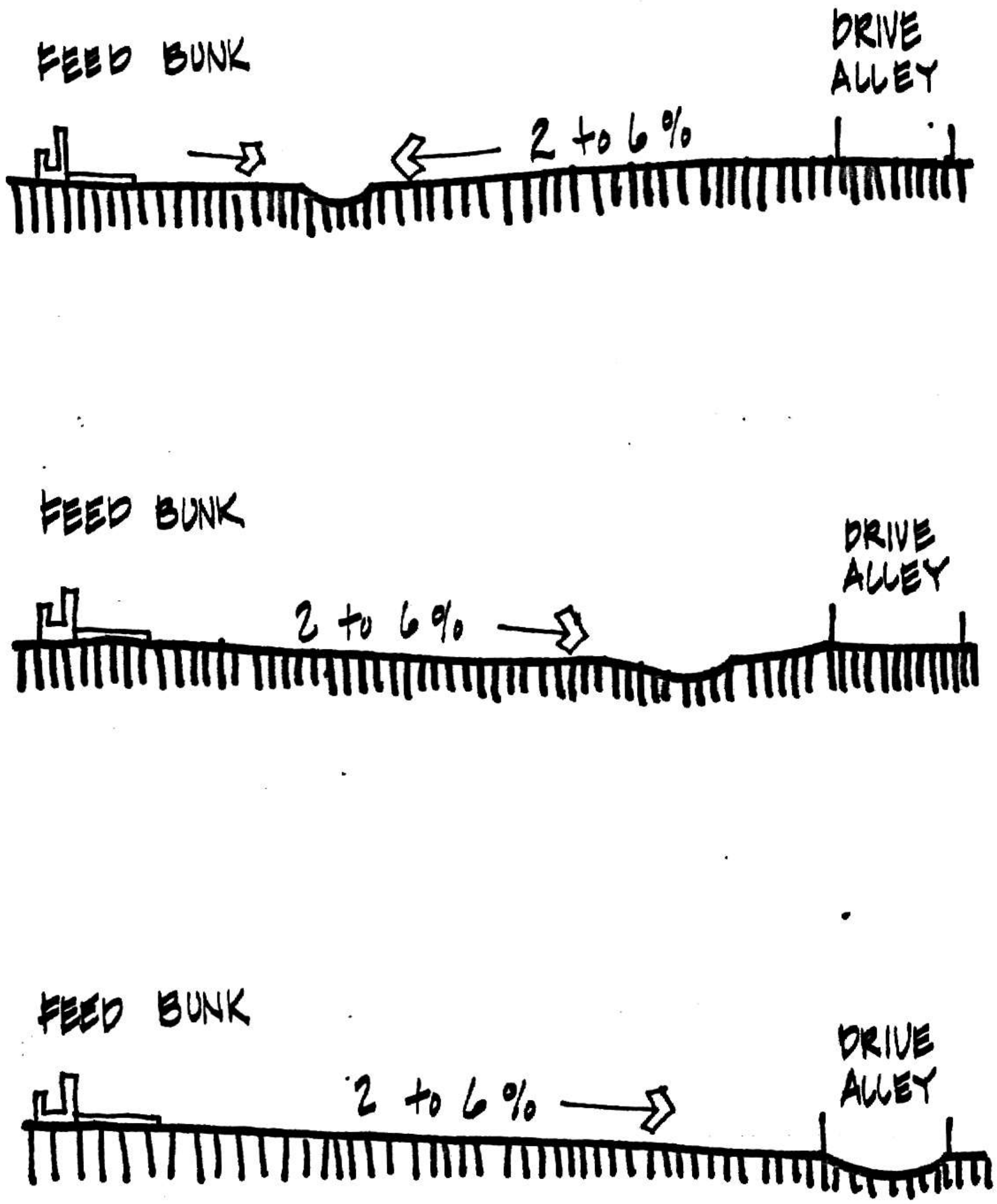
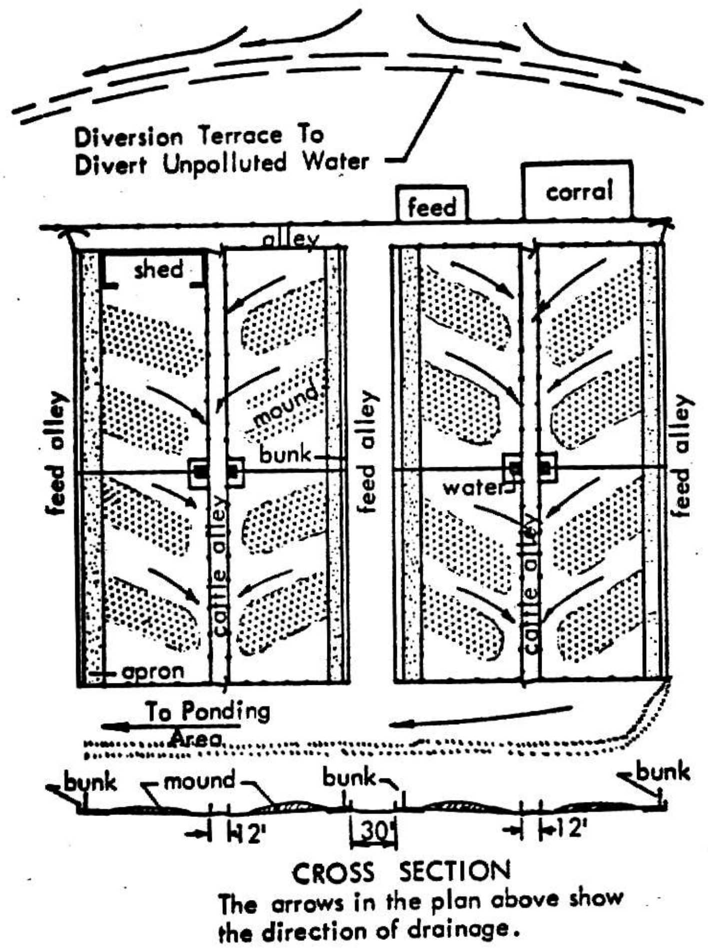


Figure 83. Methods of Pen Drainage.

Figure 84 indicates recommended patterns of pen drainage, utilizing mounding. Mounding creates a higher area, in the center of each individual pen, to provide maximum dry conditions for livestock, during wet weather.



A layout showing drainage pattern for lots along a uniform south slope. The Cross Section shows how grading provides relatively high ground at the bunks and mounds, and lower ground at the cattle alleys to provide drainage down the slope to detention ponds.

Figure 84. 'Mounding' Method of Pen Drainage.

Fencing

The most common and efficient method of feed pen layout is the rectangular grid system. This method is favored for vehicular access, cattle movement and fence construction. Fence construction, in the grid system of layout, allows for the use of common fences to form several pens. Fences are approximately 5 feet in height and constucted of wood or steel combinations. Steel cable cross members and steel pipe posts, embedded in concrete, are recommended for durability and less restriction of wind movement in pen areas. A perimeter fence should be constructed around the entire pen area, for extra protection, in case livestock would happen to break through pen fences. (44)

Feed Bunks

One side of each pen is lined with feed bunks, which actually form a part of the fencing. Feed bunks are from 22 to 36 inches high, on the feed alley side, and from 18 to 22 inches high, on the pen side. Feed bunks generally line both sides of the feed alley for more efficient operation, Figure 85. Approximately 9 to 18 inches of bunk space is required per head of pen capacity. (44) Cattle feeding schedules can vary, but usually, the cattle are fed 1 to 2 times daily.

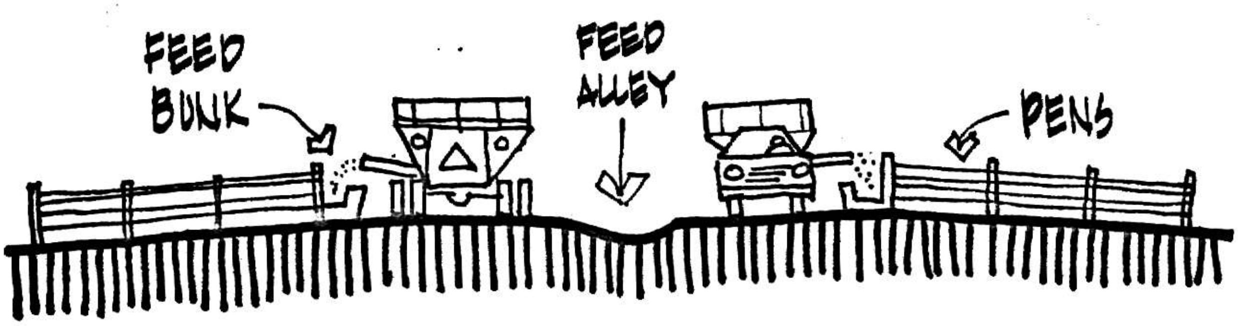


Figure 85. Feed Alley.

Feed and Drive Alleys

Feed alleys are used primarily for feed truck traffic, livestock supervision personnel and cattle buyers. Minimum widths for feed alleys with bunks on both sides vary from 20 to 60 feet. The most common width, however, is 40 to 50 feet, to allow feed trucks to pass, traveling in either direction. The amount of land saved by limiting feed alleys to the width of one truck, is insignificant, when compared to the costly traffic delays, caused by this design. (44)

In addition to feed alleys, in the feed pen layout, drive alleys should be provided at the rear of feed pens to facilitate the movement of livestock to and from the feed pens. It is not practical to use feed alleys as drive alleys because traffic circulation can be disrupted when cattle movement takes place at the same time as feeding schedules. Contamination of feed rations could also occur if cattle are moved in the feed alleys.

Drive alleys are also frequently used for solid manure removal operations to prevent contamination of feed alleys and channel liquid runoff to detention pond areas. Drive alleys are usually more narrow than feed alleys, 16 to 24 feet in width, to accommodate manure handling equipment. The slope of drive alleys should be 2 to 6 percent to provide adequate drainage, but prevent erosion problems. (44)

The components of feed pen layout; pens, fences, bunks, feed alleys and drive alleys are illustrated in Figure 86. The favored orientation of feed alleys is north-south, which allows solar radiation to melt snow and ice from both sides of the feed bunks, during winter months. This orientation also reduces snow drift patterns in feed alleys. However, the orientation depends upon drainage patterns. Feed alleys should run up and down or parallel to the existing slope for maximum drainage of feed pen areas.

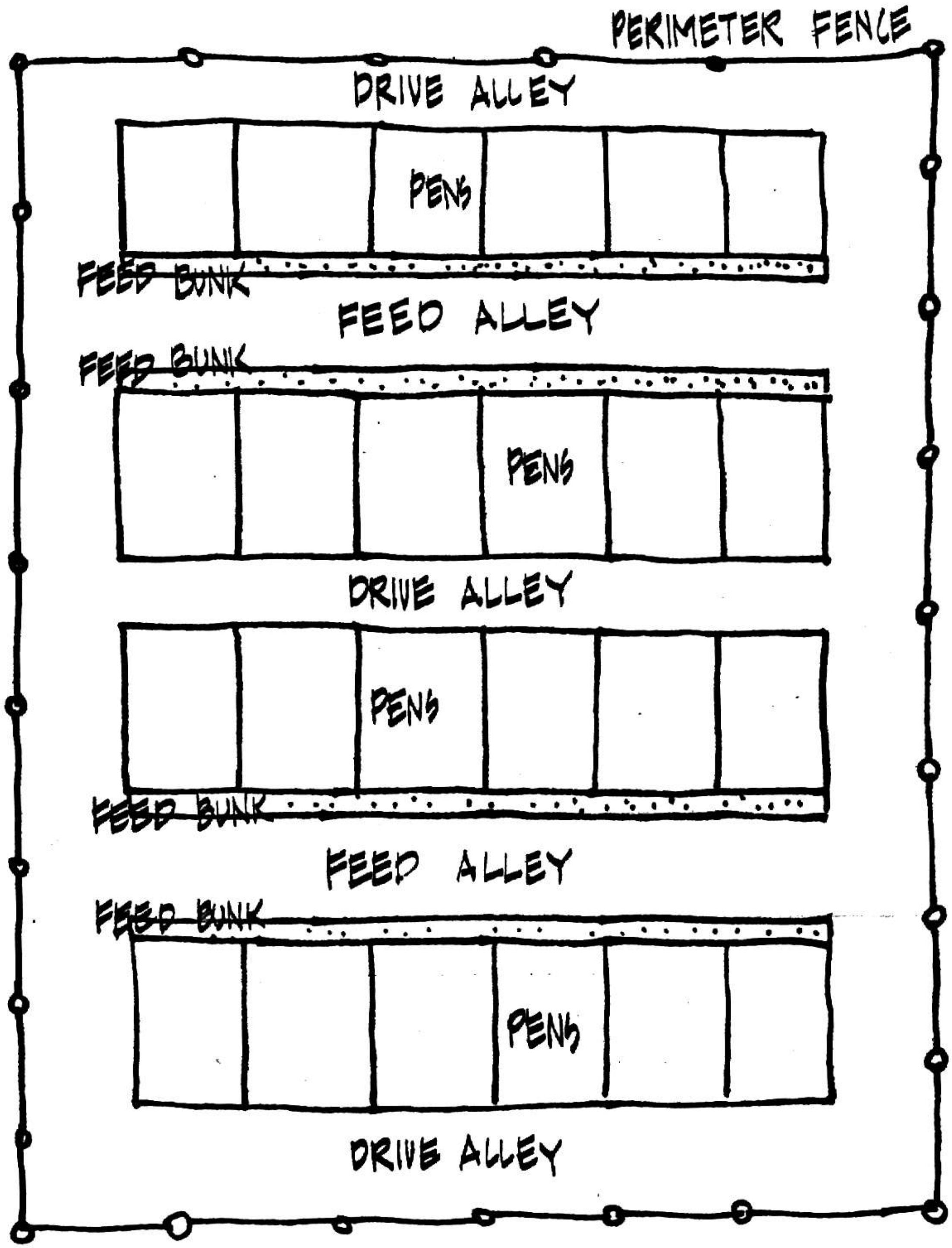


Figure 86. Feeding Pen Area Structure.

Since feed pen areas comprise the bulk of the feedlot operation, the visual impact of these sprawling, horizontal spaces, can be uninteresting and visually monotonous. To reduce the visual impact and horizontal spaces of feed pen areas, plant materials (trees) should be introduced, but in locations that would not interfere with functional operations.

Plant materials can not be introduced in the individual feed pens for several reasons: 1) Cattle, in confined areas, tend to rub vertical structures for comfort. Continuous rubbing and scratching would be detrimental to plant growth and cause eventual destruction. To prevent rubbing, additional fencing would be required, which would reduce pen areas and increase fencing costs. 2) Soil conditions, in feed pen areas, are not conducive to plant material growth. Pen surfaces tend to compact, due to livestock movement and layers of manure. Both conditions prevent surface water from percolating to root structures. Pen surfaces also contain high concentrations of soil nutrients which are harmful to plant material growth.

A careful review and analysis of the feed pen operation indicates that the most feasible location of plant materials is in the center of the feed alley where installation is not hampered by space requirements, traffic circulation, cattle movement, fencing or high concentrations of soil nutrients. A minimum width of 50 feet for the feed alley will permit two-way traffic and provide a planting strip in the middle for the installation of plant materials, Figure 87.

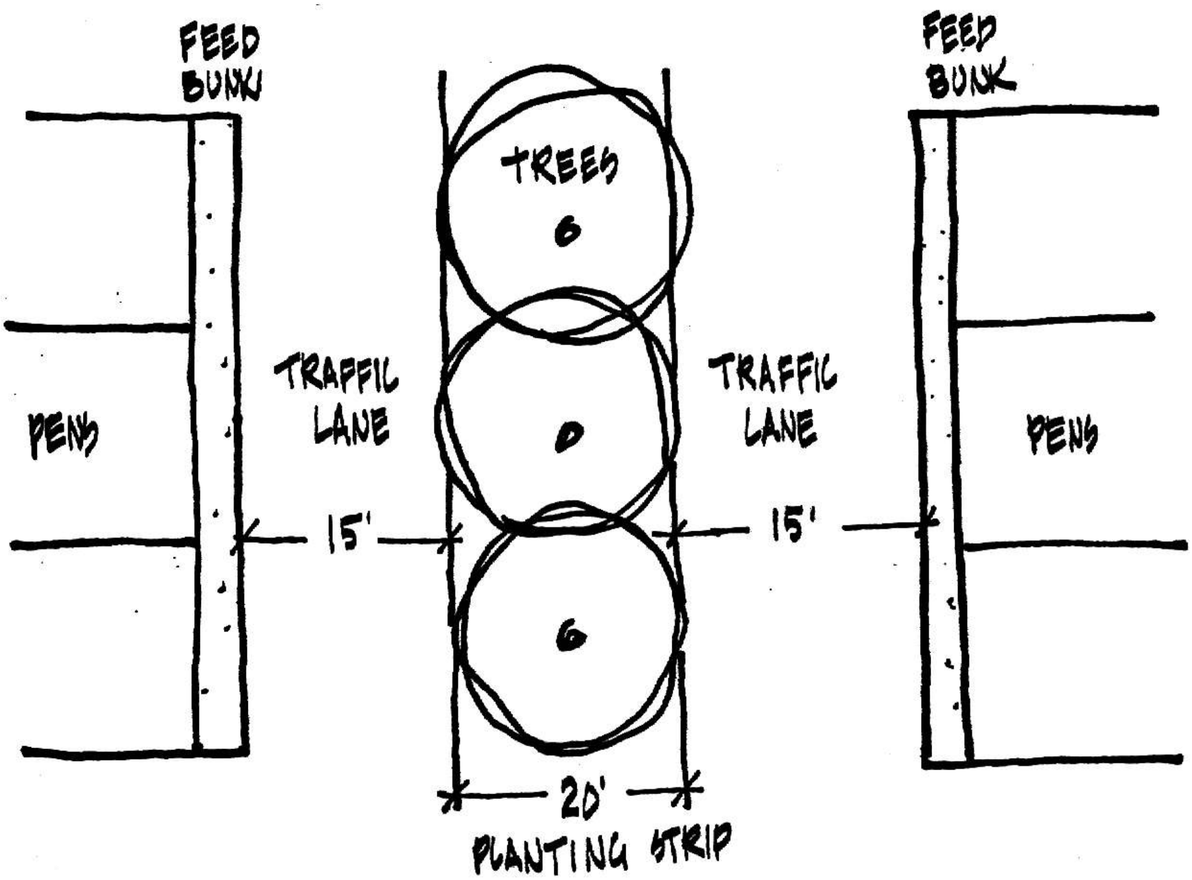


Figure 87. Feed Alley Planting Strip.

The development of the feed alley planting strip involves the consideration of: 1) traffic circulation; 2) drainage; and 3) function of plant materials. The feed alley planting strip should not extend through alley intersections, to interfere with traffic circulation, Figure 88. Turn-around spaces should be provided, at the mid-point of long feed alleys, to eliminate the need for vehicular traffic to travel the entire length of the alley to change directions, Figure 89.

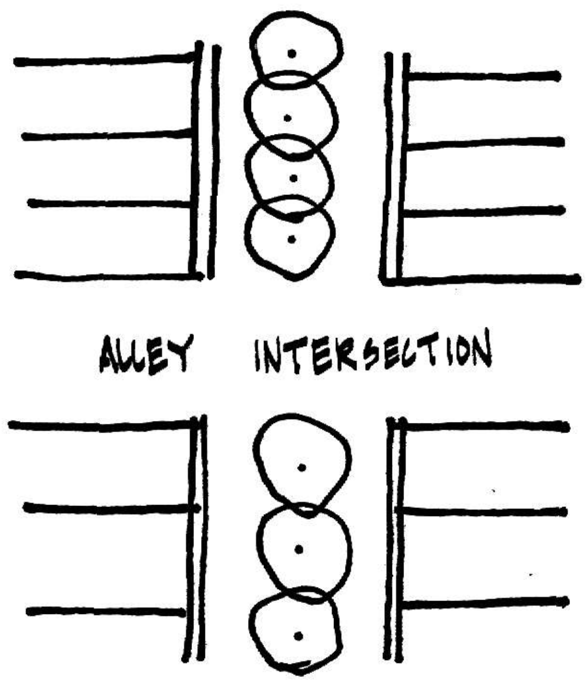


Figure 88. Feed Alley Intersection.

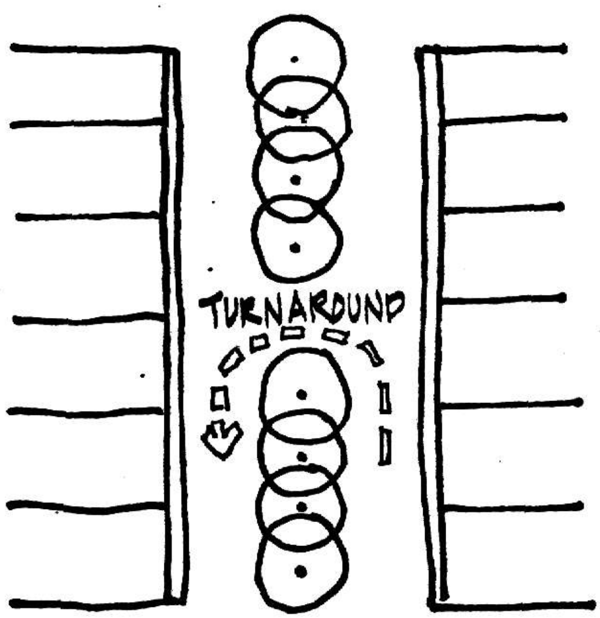
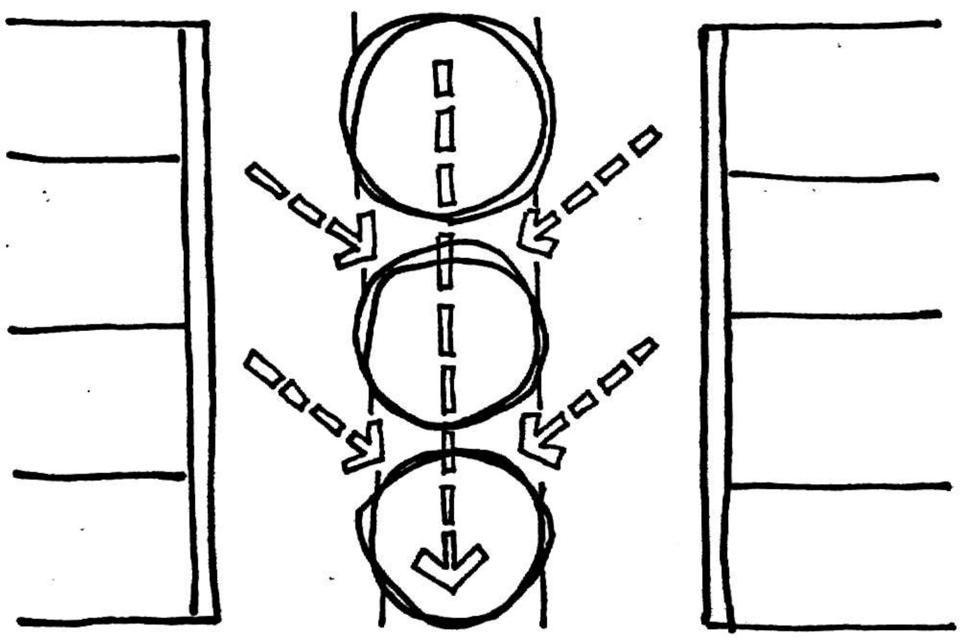


Figure 89. Feed Alley Turnaround Space.

The feed alley planting strip should also serve to channel drainage away from feed bunks and through the feed alleys. Several methods are applicable to channeling drainage: 1) the concave planting strip; and 2) the mounded planting strip, Figures 90 and 91 respectively.



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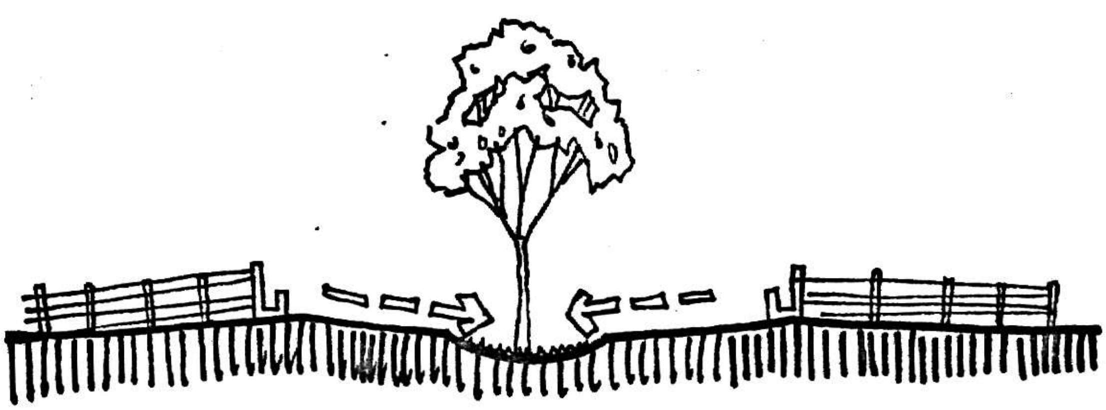
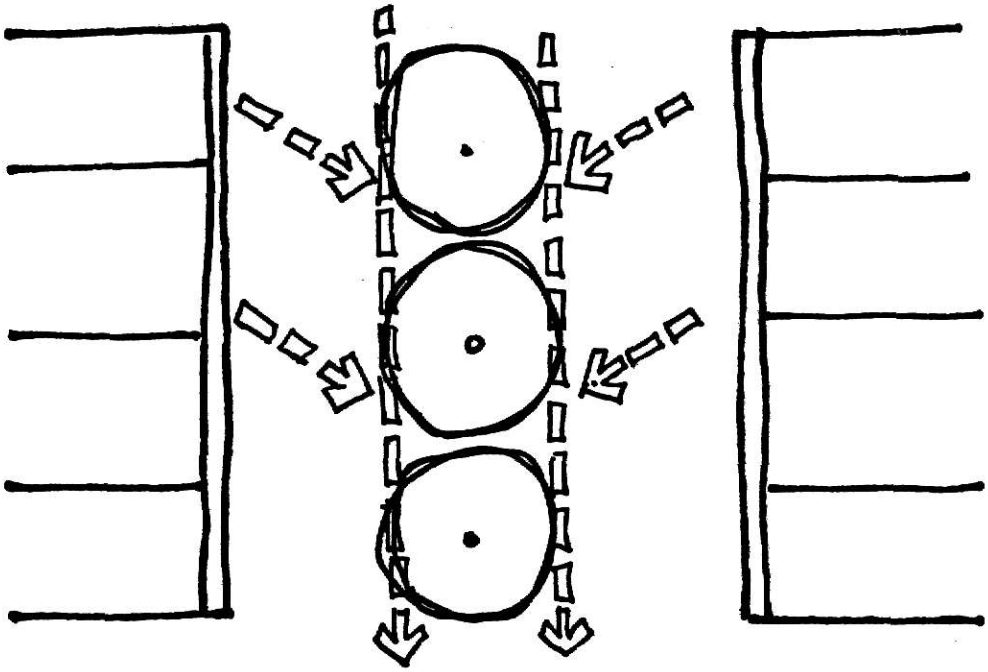


SECTION

Figure 90. Concave Planting Strip in Feed Alley.



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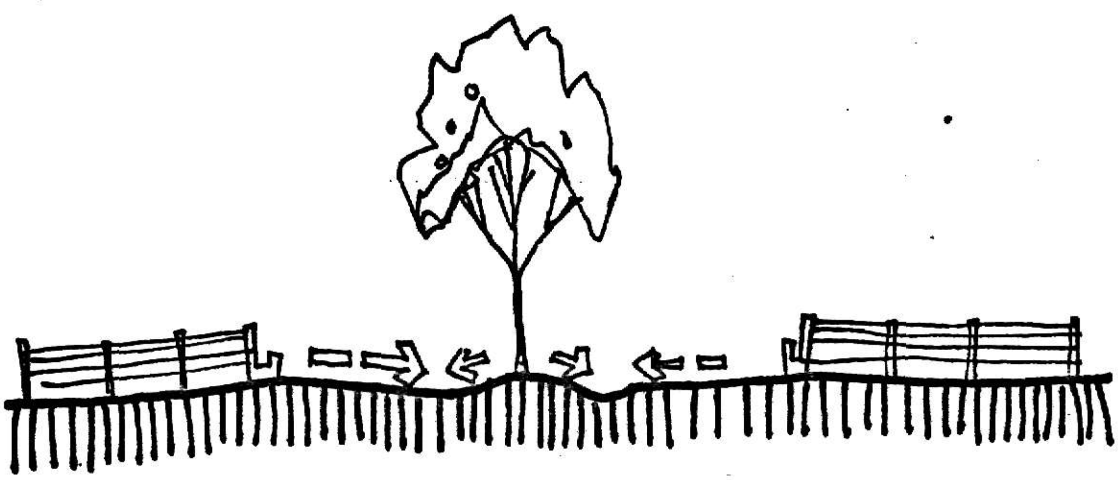

SECTION

Figure 91. Mounded Planting Strip in Feed Alley.

During winter months, the planting strip should serve as an area to blade heavy snowfalls, from feed alley traffic lanes, Figure 92.

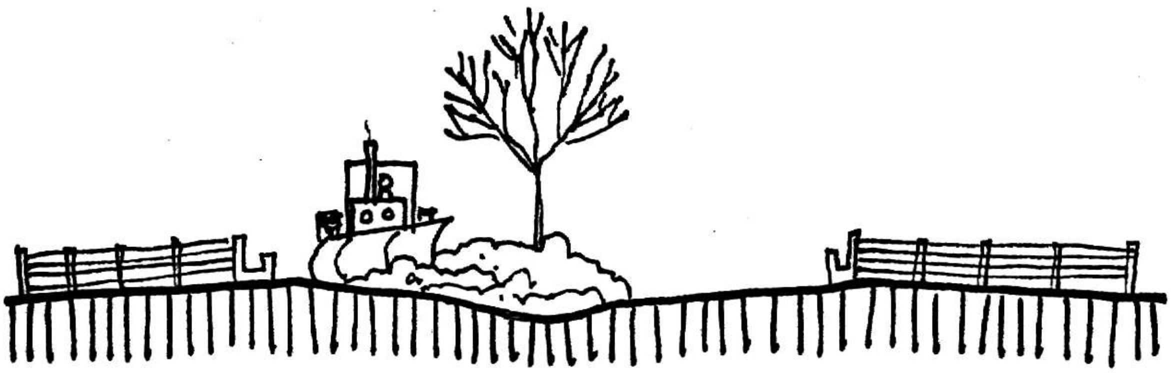

Figure 92. Snow Removal in Feed Alley.

Drainage from feed pens, adjacent to feed alleys, should not be allowed to flow through feed alleys. If waste runoff must cross feed alleys, a culvert should be provided, Figure 93.

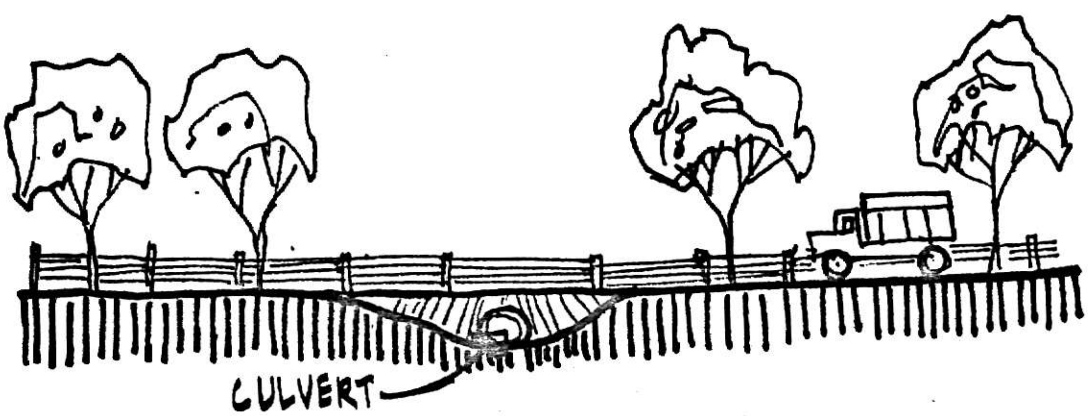

Figure 93. Culvert in Feed Alley.

The selection of plant materials, for the feed alley planting strip, should be carefully considered, to choose species that will not interfere with traffic circulation, but serve to modify climatic conditions and reduce the visual impact of large, feed pen areas. Plant material selection should be limited to large, upright growing, high crown, deciduous trees, such as; cottonwood and honeylocust, to permit vehicular movement, under and near the base, Figure 94.

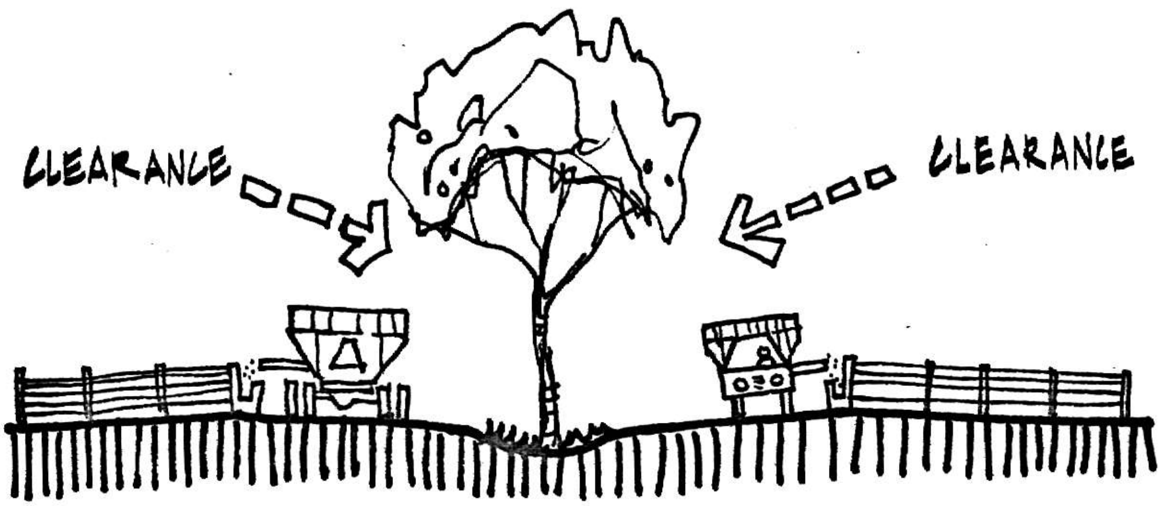

Figure 94. Trees in Feed Alley.

Large, upright growing, high crown trees are also desired to allow summer wind movement, under the tree mass, to help reduce heat stress on confined livestock, Figure 95. Shrub plantings should be avoided, as they tend to reduce wind velocities, near the ground.

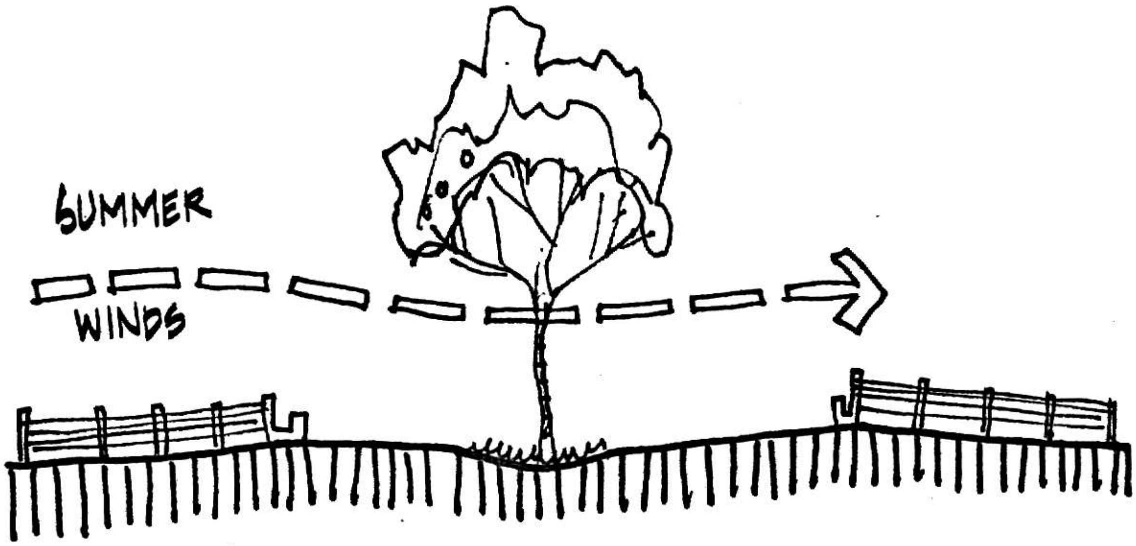

Figure 95. Summer Wind Movement in Feed Alley.

Plant material selection should be limited to large, upright growing, high crown, deciduous trees (those that lose their leaves in the fall) to permit the penetration of the sun's rays, to melt snow and ice from the feed alley area, during winter months, Figure 96.

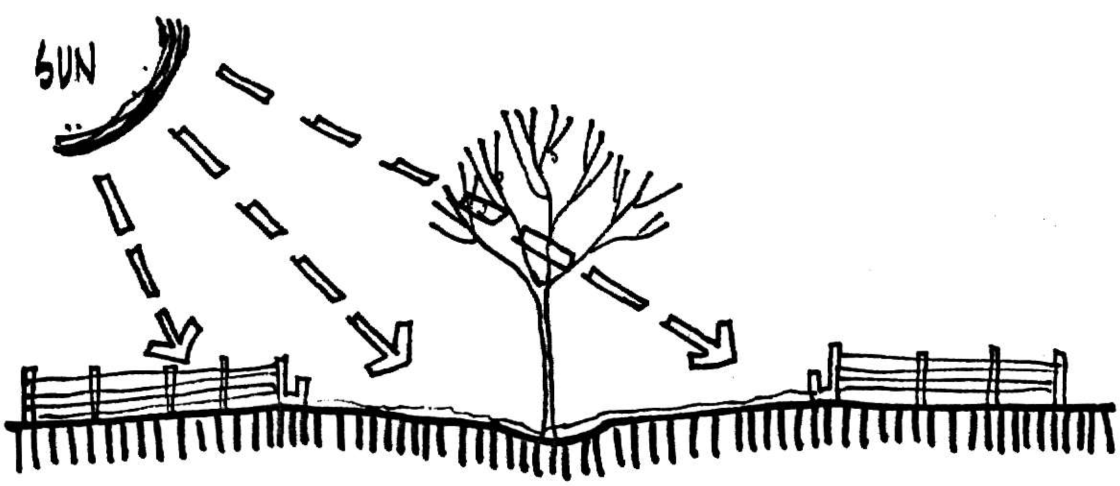

Figure 96. Snow and Ice Melt in Feed Alley.

Evergreen plant material should not be installed in the feed alley planting strip, as the foliage will tend to block sun rays, therefore, not permitting snow and ice melting, Figure 97.

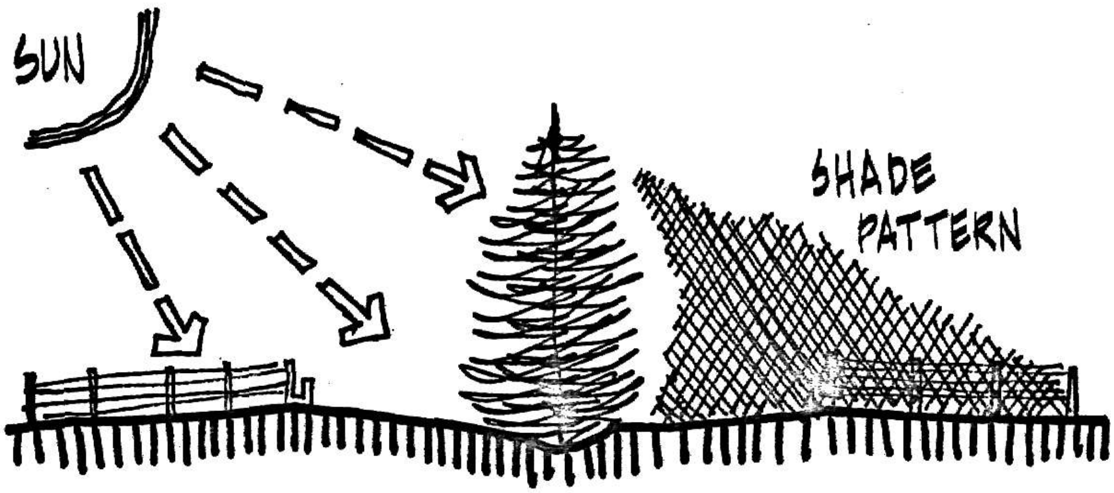

Figure 97. Evergreen Trees in Feed Alley.

The spacing of large, tall trees, in the feed alley, should be 50 to 60 feet, on center, and in a single row, to allow for maximum air movement between and under the trees, Figure 98.

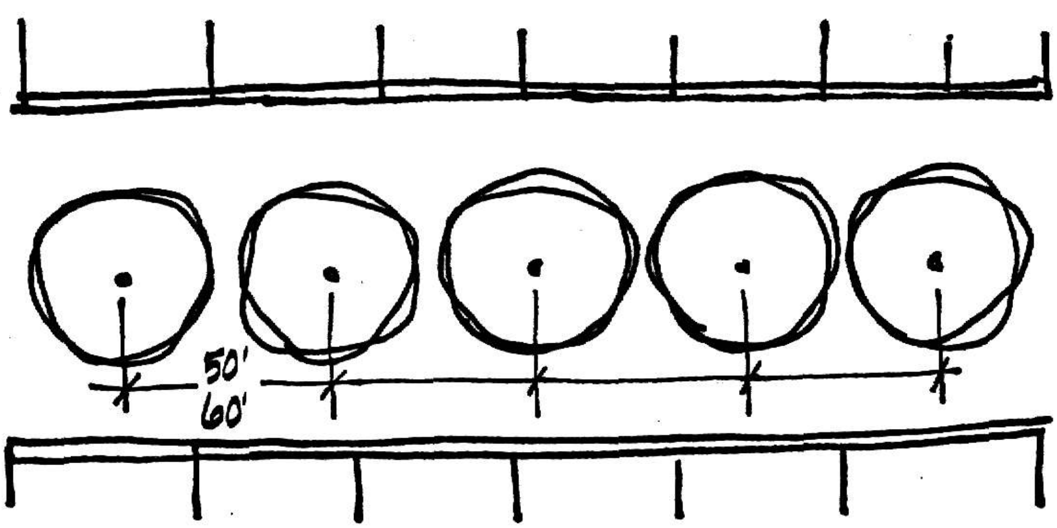

Figure 98. Plant Material Spacing in Feed Alley.

Utilizing research, mentioned in Chapter 7 (Perimeter Zone Development), which indicates that plant materials can modify atomspheric conditions, trees installed in the feed alley, would tend to reduce air temperatures, near feed bunks and adjacent feed pen areas, Figure 99. This would be particularly advantageous, in producing lower temperatures around feeding livestock. Large, tall trees would also provide shade for confined livestock, to help reduce heat stress.

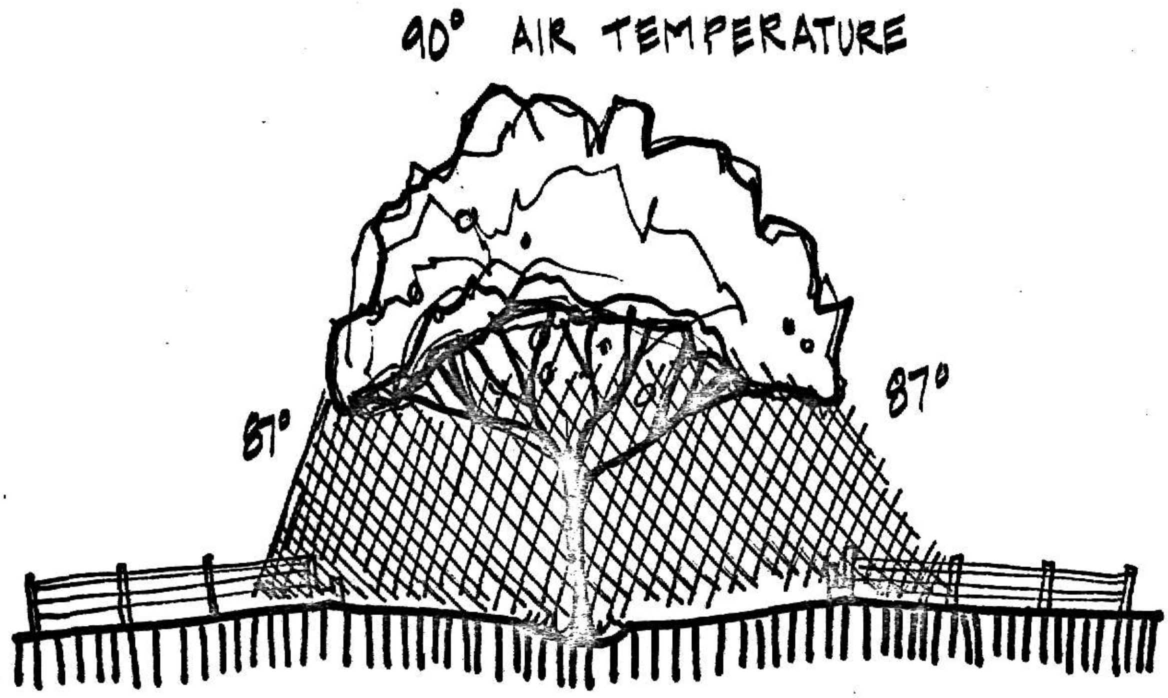

Figure 99. Air Temperatures in Feed Alley.

Research has also shown that the foliage of large, canopy trees, can absorb approximately 20 per cent of the total amount of rainfall that strikes the crown of the tree. (50) Therefore, runoff amounts would be reduced in feed alley areas, Figure 100.

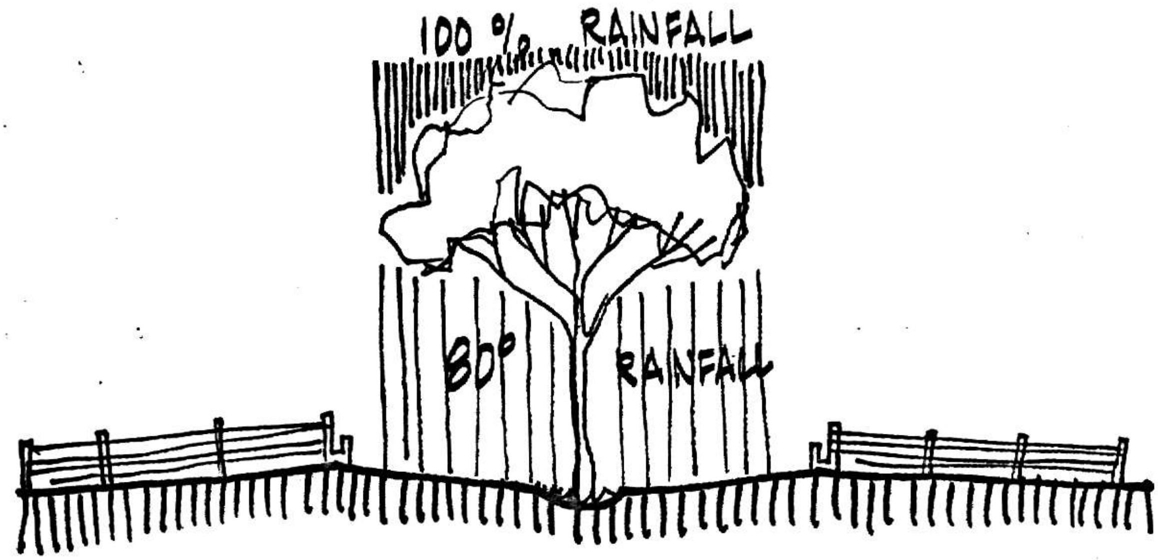

Figure 100. Rainfall in Feed Alley.

Plant materials, installed in the feed alley, could also serve to absorb noise, dust and odors generated in the feed pen areas, Figure 101.

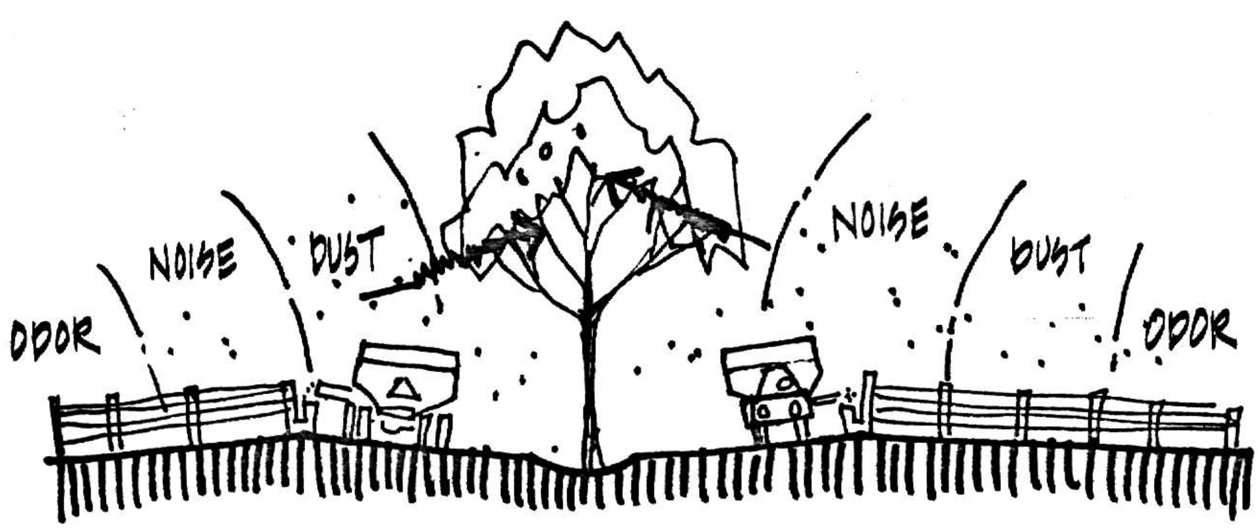

Figure 101. Atomspheric Pollution Control in Feed Alley.

Since the favored orientation of feed alleys is north-south, prevailing winds tend to move parallel with the feed alleys. This aspect is important for several reasons. Trees located in the feed alleys, are also parallel to prevailing wind movement, therefore, offering minimum resistance to air movement, Figure 102. The north-south orientation will also allow prevailing winds to blow loose debris and snow from feed alleys.

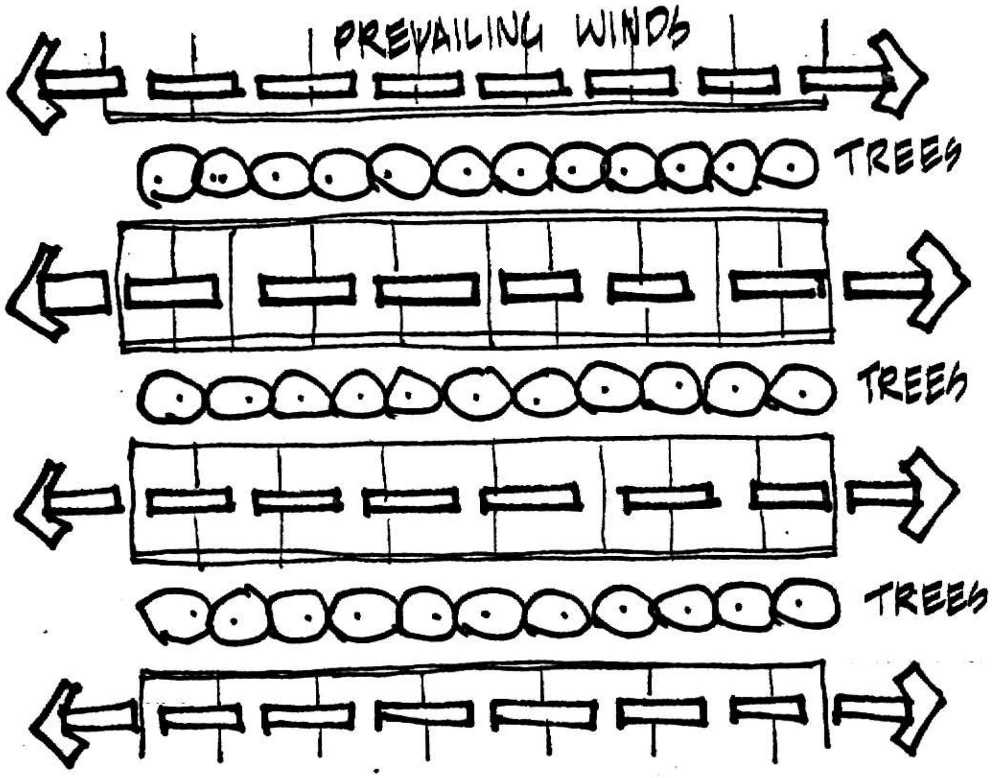

Figure 102. Prevailing Wind Movement in Feed Alleys.

Stoeckler and Dortignac (57) have shown that a narrow row of tall trees, devoid of branches near the ground, allows snow to sweep under the tree structure, depositing it in thin layers, on the leeward side. Therefore, it appears that tall trees can be located in east-west oriented feed alleys, without snow drift and wind reduction problems, Figure 103.

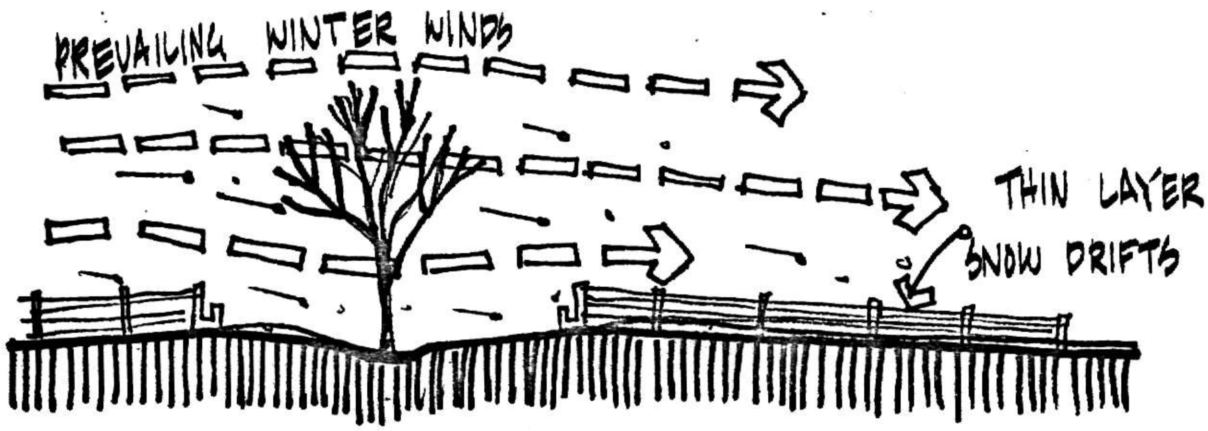

Figure 103. Snow Drift Pattern in Feed Alley.

In addition to improving the visual quality and climatic conditions, of feed pen areas, living plant materials produce oxygen and fresh-air particles, by absorbing carbon dioxide and nitrogen from the atomsphere. Carbon dioxide is exhaled as livestock breath in oxygen. Nitrogen is expelled in manure deposits. Therefore, a biological exchange could be established in a location that would be beneficial to both healthy livestock and plant material growth, Figure 104.

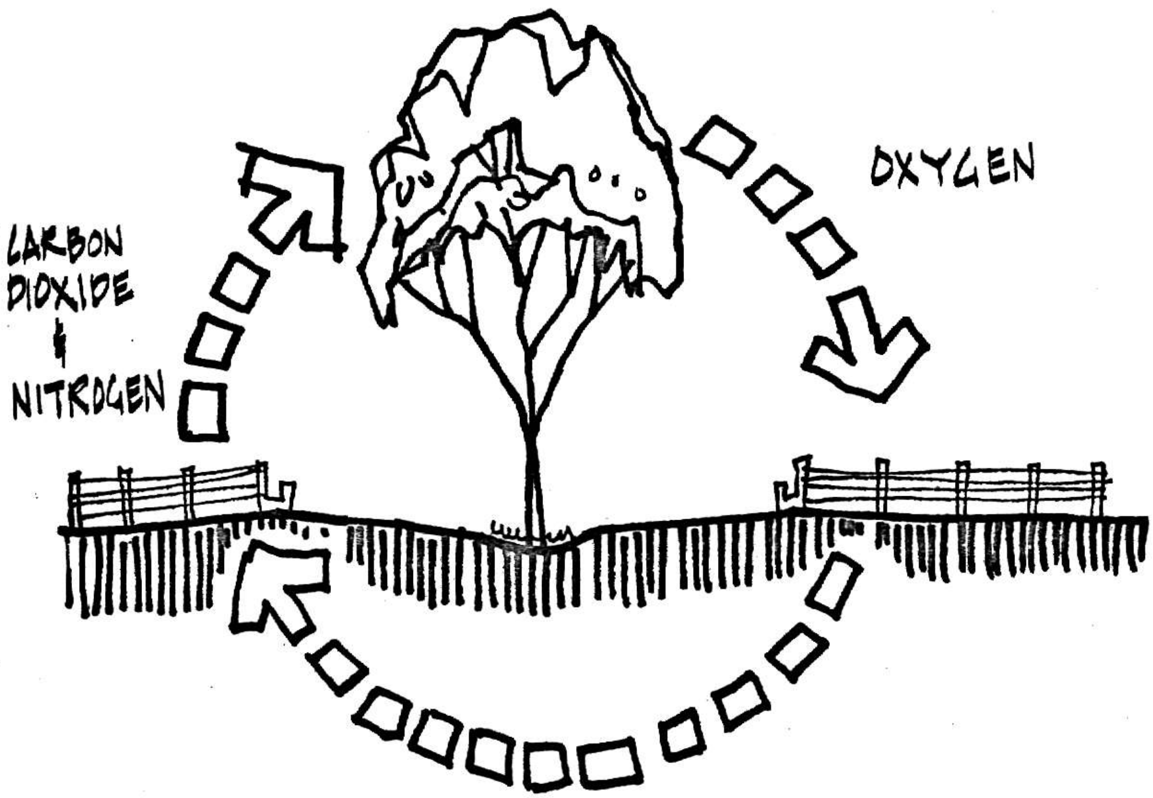

Figure 104. Biological Cycle in Feed Alley.

According to Duke and Associates (58), feedlots contribute nitrogen to the atomsphere, principally as NH_3 (volatilized ammonia). Plants in the vicinity of feedlots may derive a considerable portion of their nitrogen requirements from volatilized ammonia. Near cattle feedlots, where the atomsphere is enriched with feedlot volatiles, foliar absorption is probably higher than in normal conditions (17.8 lbs. per acre). (58) Duke and Associates data (58), suggest an important role for green vegetation in the decontamination of the earth's atomsphere.

<u>Manure Disposal Considerations in Site Planning</u>

The largest problem, presently confronting the commercial feedlot industry, is waste manure management. Unfortunately, manure has not been the profit-making aspect of the feedlot operation. However, research into alternative methods of manure disposal or 'residue utilization' has been extensive. For the most part, manure is still considered a waste material and its management can be a considerable operational expense.

Waste management practices must consider both solid and liquid manure quantities, to prevent pollution problems, and to avoid a violation of pollution control regulations, mentioned in Chapter 4. A 1,000 lb. beef animal, confined to a feedlot, consumes approximately 22 lbs. of dry feed ration and between 10 to 20 gallons of water per day. In the feed conversion process, this animal will gain approximately 3 lbs. per day, while producing around 60 lbs. of solid and liquid manure. Freshly excreted manure is approximately 80 percent moisture and 20 percent solid matter. Normal evaporation processes will reduce the moisture content, by another 50 percent, by the time for removal and disposal operations. A ton of cured manure is approximately 40 percent moisture and 60 percent solid. (59)

During the normal feeding period of 120 to 150 days, each animal, confined to the feedlot operation, will produce approximately one ton of cured manure. A 10,000 head capacity feedlot, based on a turnover rate of 2.5 to 3 times, must handle 25 to 30 thousand tons of cured manure annually. The commercial feedlot industry, in the United States, presently produces approximately 82 million tons of cured manure per year. (60) As these figures indicate, manure management is of considerable magnitude.

Manure Solids

The most satisfactory method of solid manure disposal is return to croplands. (59) Considerable research has been conducted on alternative methods of solid waste disposal, but the conclusions still favor cropland disposal, for the bulk of the quantities produced by the feedlot industry.

A study at Kansas State University researched the possibility of obtaining methane gas for energy, from solid manure. However, according to L. A. Schmid, project engineer, it is uneconomical, under present conditions, to utilize solid manure, from open-air feedlots, as a source of energy. (61)

Additional research has considered the possibilities of utilizing solid manure in feed rations for livestock, and in the manufacture of building materials, perfume, garden fertilizers and soil conditioners. While each of these methods provide a limited market for solid manure quantities, the bulk of solid manure remains for cropland disposal.

As pointed out in Chapter 5, land requirements for solid manure disposal are approximately 1 acre per 5 head of feedlot capacity. The disposal cropland should be located within a 10 to 20 mile radius, of the feedlot site, to keep handling costs to a minimum. Handling costs are about $2.00 per ton plus $0.5 cents per ton mileage. To reduce handling costs, feedlot pens are cleaned of manure, 2 to 3 times per year, or after each confined feeding period of 120 to 150 days. (59)

Solid manure application rates, to crop land, are recommended at 10 to 20 tons per acre per year. Crop lands can withstand these annual application rates, without salinity and soil nutrient build-up. Application rates, higher than 20 tons per acre, are not recommended. Figure 105 indicates the nutrient composition of solid feedlot manure. The economic value of solid manure is approximately $4.50 per ton. (59)

	Per Cent		
	Nitrogen	Phosphorous	Potassium
Mean (dry weight)	2.5	1.5	2.3
High " "	3.5	2.0	3.3
Low " "	1.0	0.8	1.2
Mean (40% moisture)	1.5	0.9	1.4

Figure 105. Nutrient Composition of Solid Manure.

Prior to crop land application, solid feedlot manure is remove from feeding pen areas by fron loaders, scrapers and trucks. It is then transported to manure stockpile areas, to allow for additional drying and decomposition. Solid manure can be spread on crop lands only in certain times of the year, mainly, before and after the growing season. Application can not be made during freezing and frozen ground conditions, or during wet weather.

Spatial requirements for solid manure stockpile areas are approximately 15 to 20 per cent of the total feed pen area. (29) A 10,000 head capacity feedlot, with total feed pen area of 40 acres, will require between 6 and 8 acres for solid manure stockpile areas. To minimize nuisance problems, the stockpile areas should be located in remote areas of the feedlot site, as far away from public roads and the operational center as possible, Figure 106.

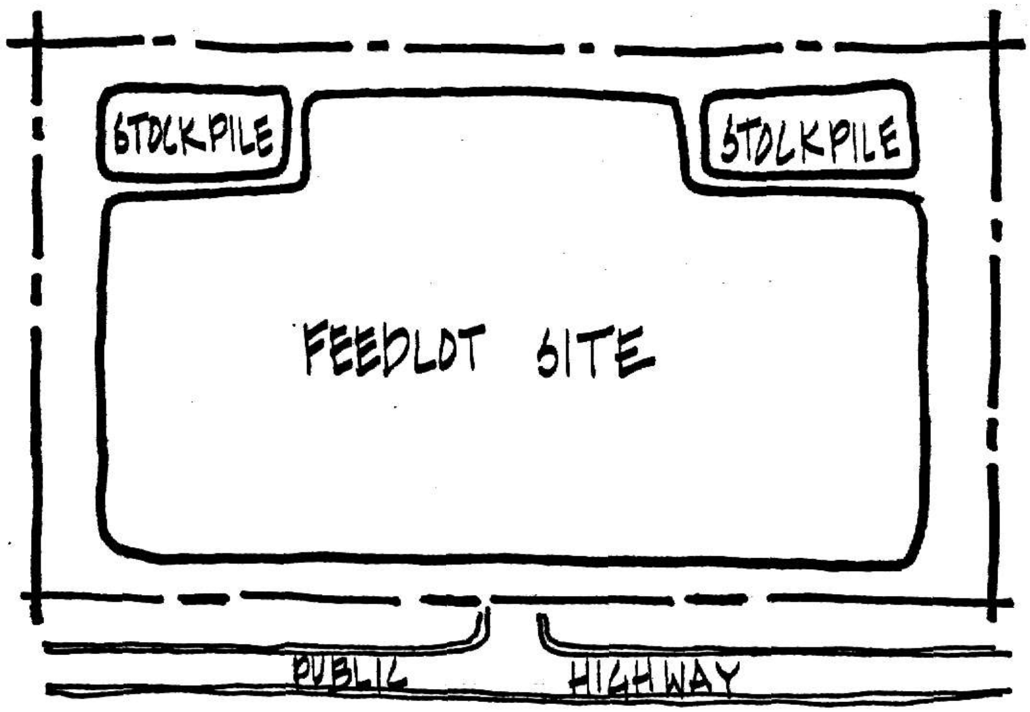

Figure 106. Solid Manure Stockpile Areas.

The stockpile area should be designed to eliminate all runoff water, from up-slope areas, from draining through the area, thereby, avoiding contact with stockpiled manure. Drainage, originating from the stockpile area, must be handled in the same manner as runoff from feed pen areas and directed into a drainage system that flows into liquid detention lagoons. (29) To eliminate extensive drainage systems, the stockpile areas should be located adjacent to the liquid runoff detention lagoons, Figure 107.

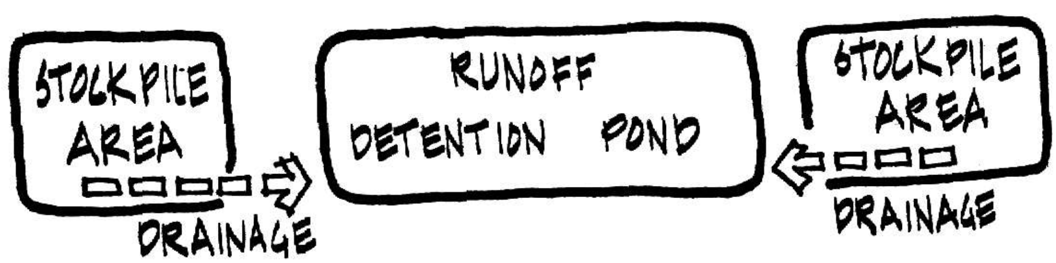

Figure 107. Solid Manure Stockpile Area Drainage.

Since solid manure is transported by trucks, vehicular access to the stockpile area is important. Roads should have a minimum width of 30 feet and turning radii should be a minimum of 40 feet. Roadbeds should be designed to accommodate heavy load bearing capacities and paved to reduce dust and muddy conditions.

Solid manure stockpiles can reach heights of 10 feet and contribute to visual, as well as nuisance problems. Visual screens, composed of plant materials and earth berms, should be utilized to screen views of the areas, Figure 108.

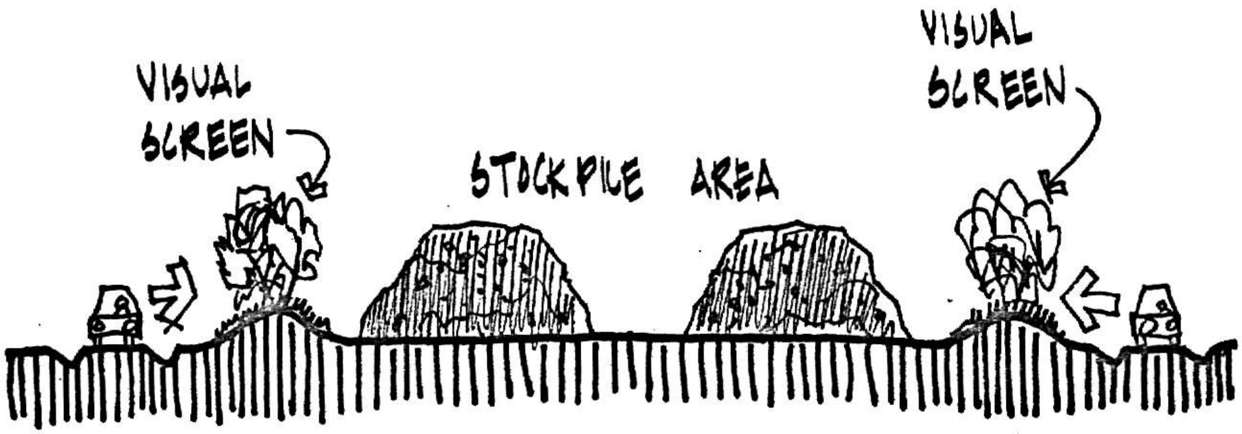

Figure 108. Visual Screening of Stockpile Area.

Solid manure stockpiling operations can create dust, noise and odorous conditions. Plant material and earth berms should also serve to reduce wind velocities and blowing dust conditions, as well as absorbing pollution particles in the atomsphere, Figure 109.

Air movement through solid manure stockpiling areas should not be excessively restricted, to permit air-drying of composted manure. Plant materials adaptable to visual screening include such species as; redbud, russian olive and hawthorn. Evergreen plant materials should not be used extensively, as they tend to restrict air movement very much.

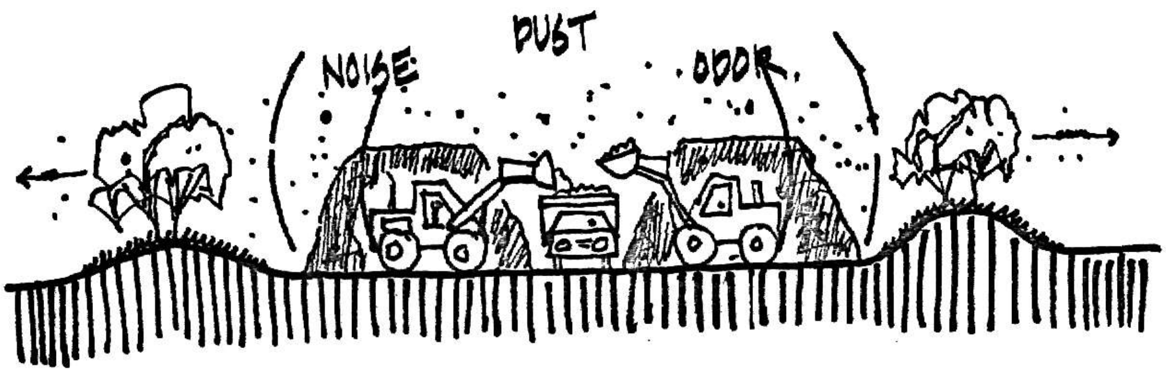

Figure 109. Nuisance Pollution Control in Stockpile Area.

Earth berm development, in addition to providing visual screening and spatial definition, should serve to direct drainage, from up-slope areas, away from the stockpile area. Berms should also be used to direct drainage, within the area, to liquid runoff detention ponds, Figure 110.

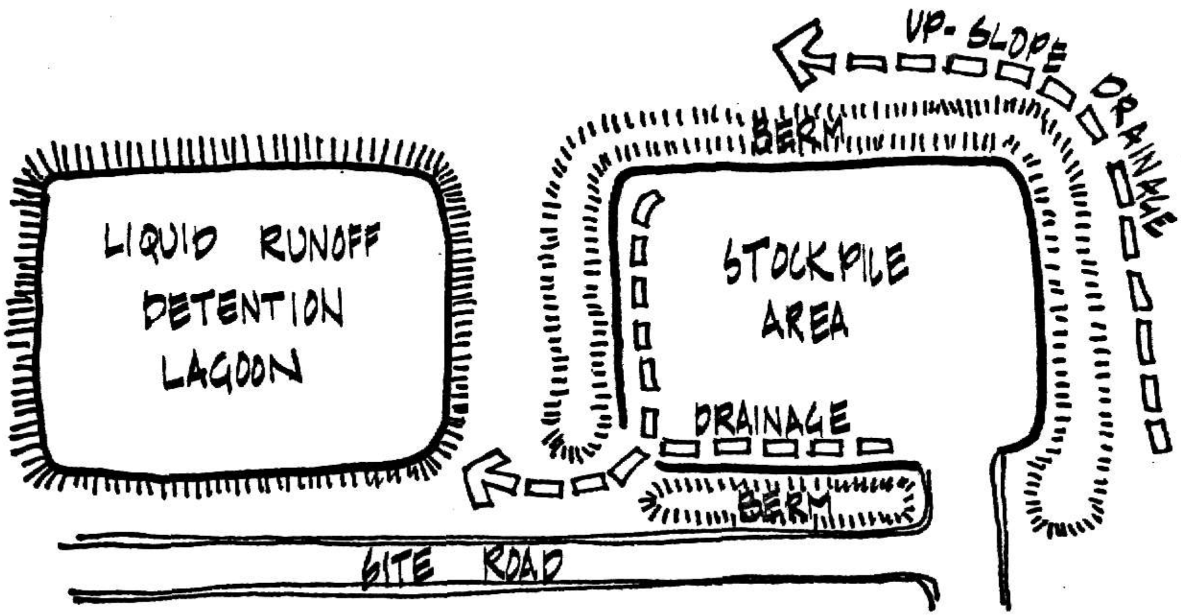

Figure 110. Stockpile Area Structure.

Earth berms should be approximately 5 feet in height to provide visual screening. Slopes should not be over 3 to 1. To prevent erosion problems, the slopes should be planted with ground covers, such as; brome, crown vetch, buffalo grass and ryegrass. These ground covers will also serve to absorb dust, odor and noise generated within the stockpile area.

Liquid Manure

As indicated in Chapter 4, the control of feedlot runoff is required, by Federal and State water pollution control regulations. Although most commercial feedlots have liquid runoff detention systems, it is possible for a feedlot to operate without such systems, if the feedlot operation does not contribute to soil and water pollution. For most feedlot operations, a liquid runoff detention and disposal system consists of; drainage patterns, debris settling basins, detention lagoons and an irrigation system, Figure 111.

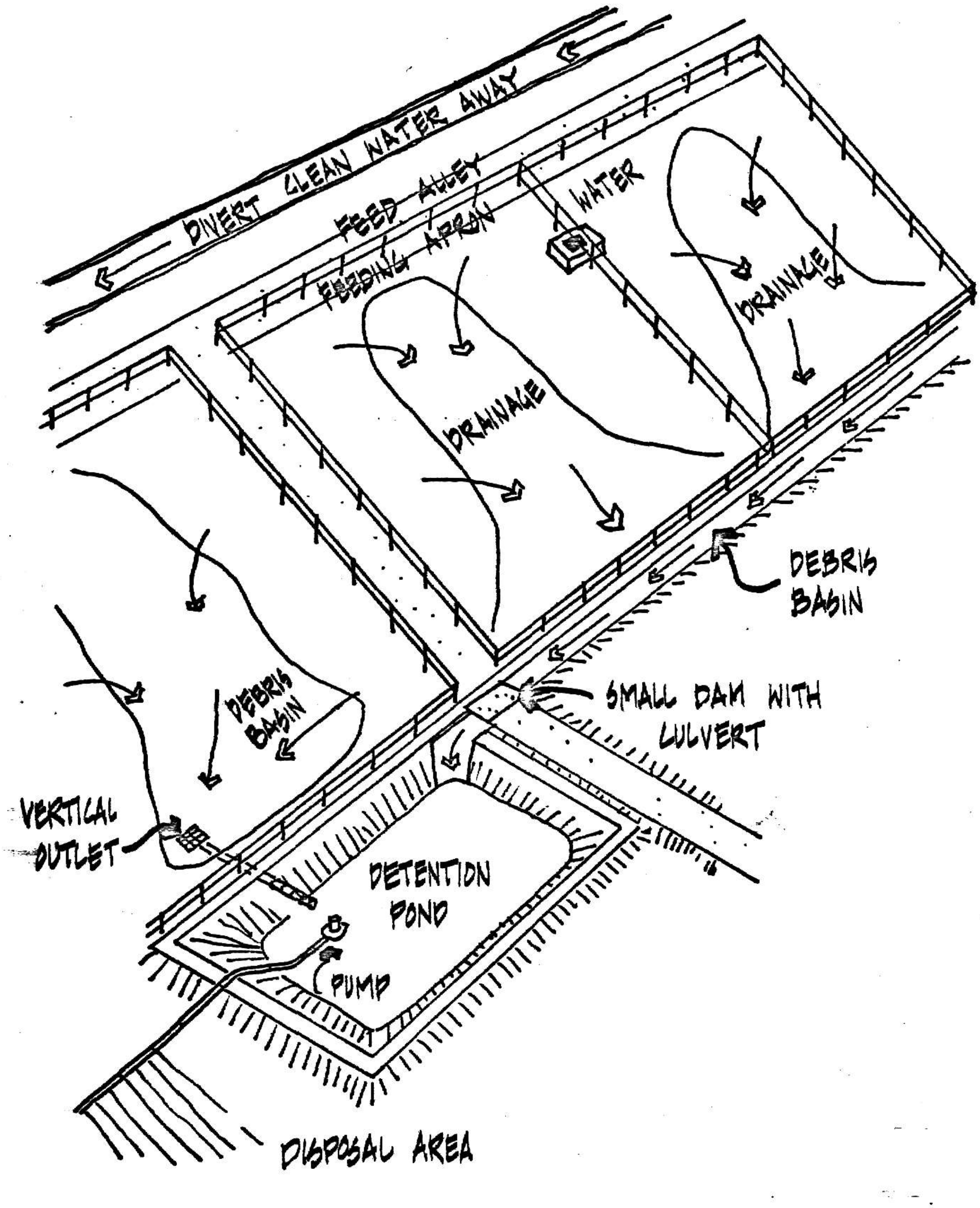

Figure 111. Liquid Runoff Detention and Disposal System.

The location of the liquid runoff detention lagoon requires careful considerations, since it can be the major source of environmental pollution. The detention lagoon must be located at the lowest elevation on the feedlot site. The detention lagoon, in addition of the solid manure stockpile area, should be located in remote areas of the site, and as far away from public roads and the operational center, Figure 112.

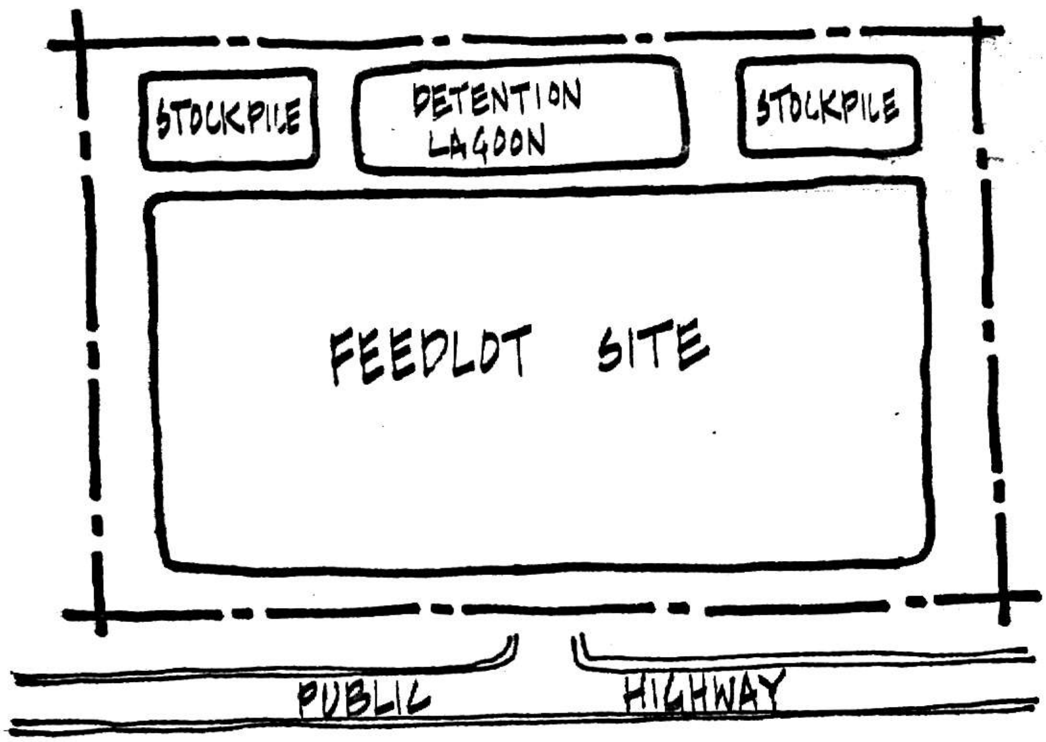

Figure 112. Liquid Runoff Detention Lagoon and Stockpile Areas.

Spatial requirements, for liquid detention lagoons, will vary depending upon local rainfall amounts and climatic conditions. As pointed out in Chapter 4, the lagoon must be capable of holding maximum runoff, from either a 10 year or 25 year, 24 hour design storm. Generally speaking, an area approximately 2 to 15 per cent of the total feed pen area, is needed for a detention lagoon. (29)

A 10,000 head capacity feedlot, with total feed pen area of 40 acres, will require about .8 to 6 acres for a detention lagoon, depending upon climatic conditions.

In additional to locating the detention lagoon in remote areas of the site, crop fields should be adjacent to the facility, for minimum irrigation pumping distances. As pointed out in Chapter 6, a 10,000 head capacity feedlot will require approximately 60 to 80 acres of cropland, for the disposal of liquid runoff. This area is equal to 1½ to 2 times the total feed pen area.

Crop land irrigation is presently the most favored method of liquid runoff disposal. Crop land utilized for liquid runoff disposal, should not be utilized for solid manure disposal and visa-versa. Desirable application rates for liquid runoff disposal range from 4 to 8 inches per year. (29)

Liquid runoff detention ponds should not be overly large, in surface area, and in regard to economic feasibility and pollution problems. However, the structure must be adequate to provide maximum detention of surface runoff. Detention ponds should have unifrom depth of 48 inches or greater, and side slopes of 3 to 1 maximum, to allow persons or animals to climb out of the structure. (58) For safety purposes, the entire detention pond should be fenced.

Since detention ponds also serve as evaporation basins for liquid runoff quantities, wind movement through the area, should not be excessively restricted. Therefore, densely spaced plant materials, around the pond area, are undesirable. However, ground covers such as; bromegrass, crown vetch and ryegrass should be maintained on side-slopes and berms to prevent erosion and dust problems.

Liquid detention ponds can be the source of odor pollution and uninteresting views. To improve the visual quality, of the detention pond area, a limited number of large trees, should be openly spaced around the area, Figure 113. The limited number and open spacing of trees, such as; austrian pine, hackberry and honeylocust, will offer little resistance to air movement.

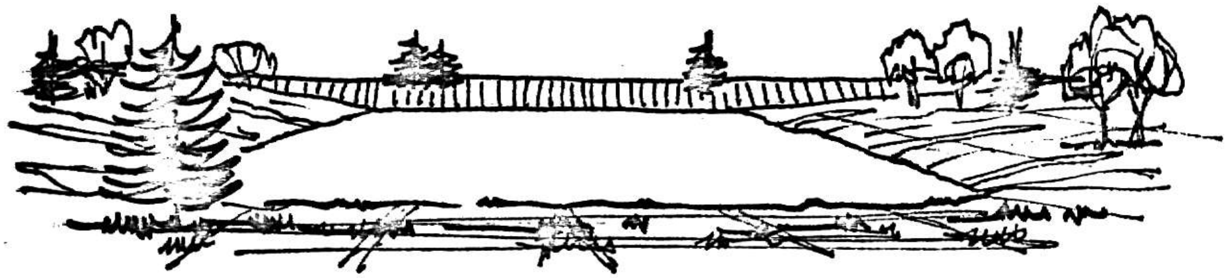

Figure 113. Plant Materials in Liquid Runoff Detention Pond Area.

Tree placement should be above the maximum holding capacity level of the detention pond, Figure 114.

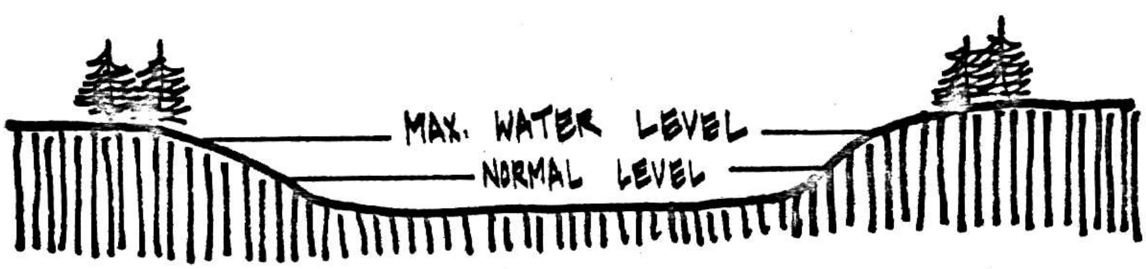

Figure 114. Plant Materials Above Maximum Water Level in Detention Pond Area.

Earth berms could also be utilized to form visual screens and increase holding capacities for the detention structure, Figure 115. Berms should be used to provide vehicular access to the detention pond area. The height of the berms should be around 5 feet, with maximum slopes of 3 to 1.

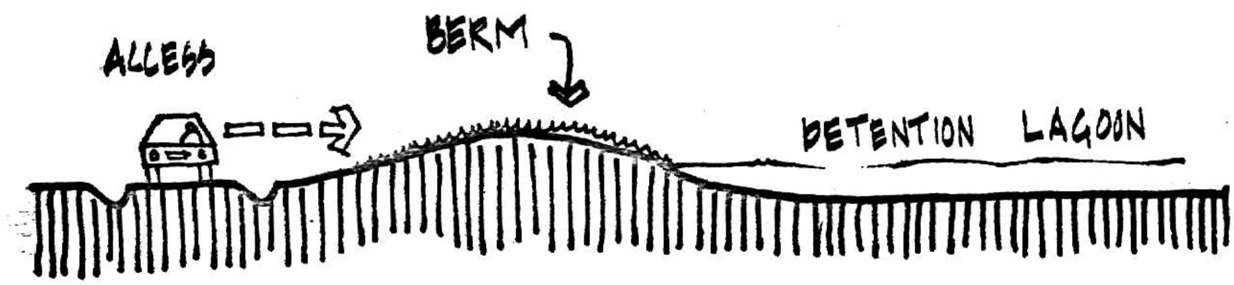

Figure 115. Berms in the Liquid Runoff Detention Pond Area.

CHAPTER 8

SITE DETAILS AND PLANTING DESIGN FOR FEEDLOT SITE PLANNING

Site Details

Site details such as; signing, roads, buildings, color, lighting and maintenance programs, are very important to the visual appearance of the commercial feedlot operation. Often overlooked, these site details can result in the difference between a visually appealing and visually displeasing site appearance. (62)

The implementation of site details should be coordinated with the total feedlot site development and not considered as decoration or extras. The purpose of site detailing is to solve design problems functionally, visually and economically.

Signing

Signing, to be effective, should perform the basic functions of information transfer, direction and/or instruction. To accomplish these functions, signing should be simple, brief and attractive in appearance. Simplicity of signing requires that the shape, lettering and color be easily recognized and assimilated as viewers are often moving past in vehicles. Signing should also enhance the visual quality of the site by relating to the character of the total site development. (62)

Signing is generally of two types: 1) informational and 2) directional/informational. Informational signing is used at the entrance of the site and within the site to define location. Directional/informational signing is utilized to provide a smooth flow of vehicular traffic and insure safety.

The message of signing can be conveyed by the use of words, symbols or a combination of both. Word messages are generally used for informational signing, while symbols are more effective on directional signing, Figure 116. (52)

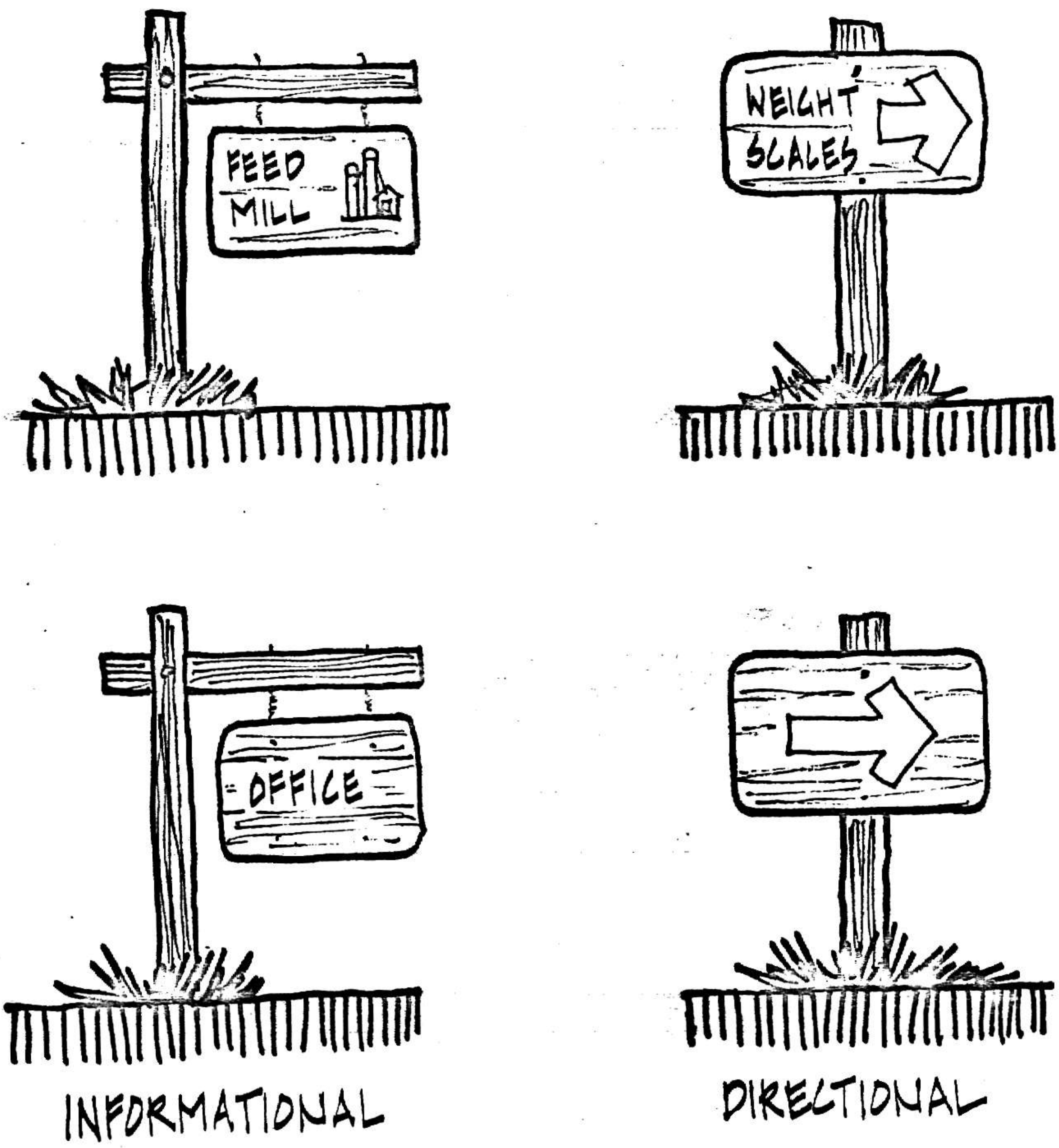

Figure 116. Signing Types.

Signing should be located only in areas, where a possible conflict could occur, if signing was not present; such at intersecting roads. There should be a minimum of signing, as the more signing, the greater the amount of possible confusion. If several messages are necessary, at one location, they should be combined in a simple and visually appealing manner, Figure 117.

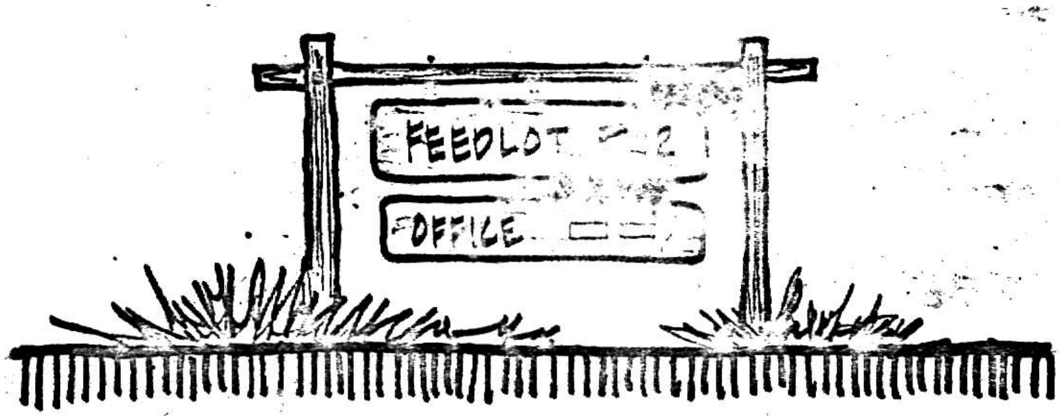

Figure 117. Signing in Combination.

Construction materials, for signing, are numerous; wood, metal, plastic or combinations of each. For signing to have the most effective contribution to total site appearance, the materials selected, should relate to the character of the site operation. For example, if the feedlot operation has numerous wood fences and structures, signing constructed of wood materials, provides a good relationship in site appearance. If metal is the predominant building material, signing of metal materials, is more in character with total site appearance. Once a material for signing is selected, all signing should be constructed of the same material, shape and form, to maintain continuity, Figure 117.

Interior Site Roads

Ease of vehicular access and traffic flow, in the commercial feedlot operation, is a functional necessity. To insure traffic safety, interior site roads should be paved for stable road conditions in all kinds of weather. Since vehicular traffic can create dust problems, roads should be oiled, watered or paved to maintain dust-free conditions. The road system should also be used as part of the site drainage system, shown in Chapter 7.

Color

Color can be an important aspect of total site appearance. Miner (28) emphasized the use of color to help reduce the perception of nuisance pollution. According to Baxter (43), the major concern with color is the appropriateness of its use.

Colors, in nature, are blended in harmonious tones of brown, green and blue. Therefore, to reduce the environmental and visual impact of feedlot operations, earth tone colors might best be used on facility structures.

Another approach to color usage is the principle of contrast which suggests that bright, bold colors used in visually pleasing combinations can accent the structural features of the commercial feedlot operation. It was noticed during the field trips that this approach to color is presently used in some feedlot operations.

Lighting

Most feedlot operations incorporate lighting into site planning for reasons of safety, illumination of work areas, vandalism control and providing an atmosphere conducive to keeping livestock quiet and feeding during nighttime hours.

Whatever the reason for lighting, the location and type of lighting fixtures should be compatible with other site details for visual appearance.

Underground installation of electrical wiring should be provided to eliminate masses of overhead wiring which can be visually disrupting to total site appearance.

The major considerations in the location and intensity of lighting is that it should reflect the importance of the area. (63) Care should also be exercised to prevent glare, excessive bright conditions or shadow patterns which could blind the viewer.

Site Maintenance

The visual quality of a commercial feedlot operation can be greatly improved by an effective program of total site maintenance. According to Shuyler and Associates (29), a psychological, public victory can be won by keeping the feedlot site and facilities in good repair. A neat, well-maintained facility is a necessity for leaving neighbors, visitors and passers-by with a desirable impression. A poorly kept site is usually expected to be in violation of environmental controls.

Site maintenance programs should be established to maintain a quality feedlot appearance and to eliminate any possible basis for public nuisance complaints. These programs should include steps to reduce:

1) atmospheric pollution caused by dust, noise and odor.
2) nuisances such as rodents, birds, insects and dead animals.
3) movement of manure pollutants to adjacent public land.
4) disease transmission from livestock to people.
5) broken fences, bunks and roads.
6) weed growth and trash.

Such maintenance programs not only improve the visual appearance of the feedlot site, but also provides for greater efficiency of operations. (29)

Planting Design

Although plant material usage, in commercial feedlot operations, is not practiced extensively at the present time, this study has shown that plant materials can serve important functions in the development of the commercial feedlot site:

1) Screen unsightly views of the site.

2) Reduce climatic effects of sun, wind, rain, snow, temperature and erosion.

3) Control nuisance pollution of dust, noise and odor.

4) Improve the visual and environmental quality of the operation.

Plant Material Selection

The commercial beef cattle feedlot operation requires planting design that is developed in a functional manner, not 'ornamental decoration'. In the selection of plant materials, care must be exercised to obtain species that are well adapted to the specific soil and climate of the feedlot area. Plant materials should be selected that require low maintenance and care under natural conditions. Some care and maintenance will undoubtedly be required in the early stages of installation, but once established, plant materials should be self-sufficient, in terms of maintenance.

The selection of plant materials involves knowledge of plant classifications, growth characteristics and their ability to serve the function for which they are selected. Plant material classifications, according to Baxter (43), are:

1) Ground cover plants, up to 3 feet in height.

2) Evergreen and deciduous shrubs, from 3 to 15 feet.

3) Small flowering trees, from 10 to 30 feet.

4) Large evergreen trees, from 15 to 50 feet.

5) Large deciduous trees, to 100 feet.

Ground Covers

Plant materials in this group can grow to 3 feet in height and include such grasses, vines, and low growing shrubs as crown vetch, clover, ryegrass, buffalograss and creeping juniper. Their primary purpose and function is erosion control, area coverage and improving the visual appearance of land surfaces, Figure 118.

Figure 118. Ground Covers.

Evergreen and Deciduous Shrubs

Plant materials in this group can obtain heights from 3 to 15 feet, and are often used as eye-level screens and barriers for spatial definition, Figure 119. Pfitzer uniper, lilac, forsythia, dogwood, honeysuckle and multiflora rose are examples of plant materials in this classification.

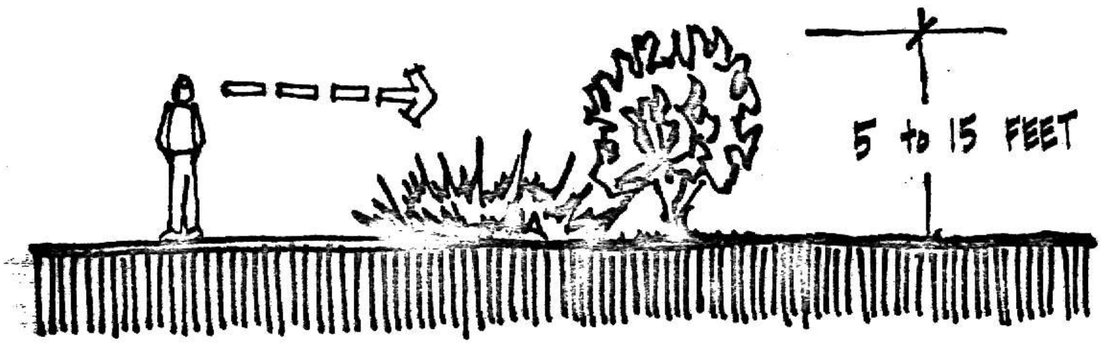

Figure 119. Evergreen and Deciduous Shrubs.

Small Flowering Trees

These plant materials can obtain heights of 10 to 30 feet. Their function is to provide visual emphasis, in public exposed areas, Figure 120. They ca also serve to form visual screens and spatial definition. Redbud, russian olive, hawthorn and mulberry are examples of plant materials in this group.

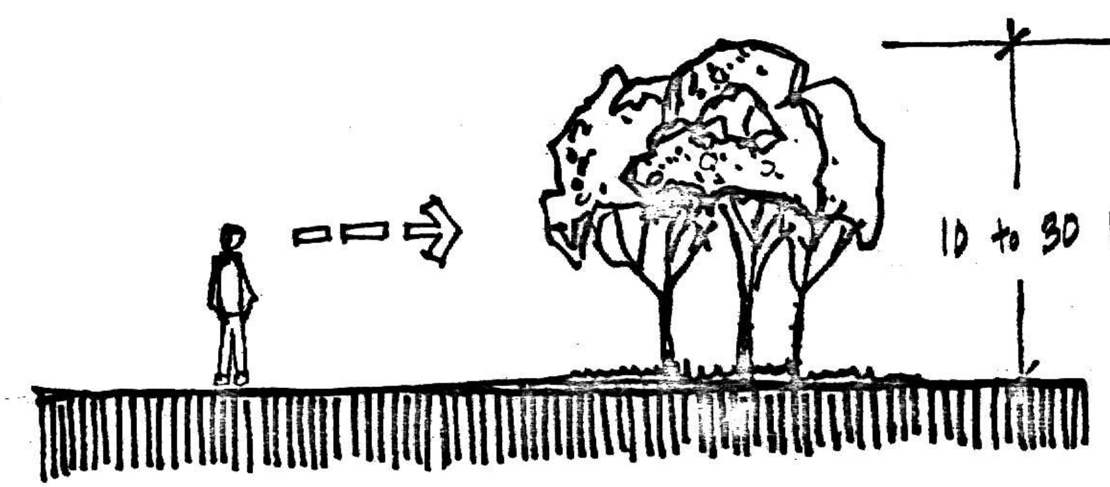

Figure 120. Small Flowering Trees.

Large Evergreen Trees

Plant materials in this group can grow to heights of 15 to 50 feet. They serve to provide accent, winter color and contrast to group plantings. These plant materials are very effective for spatial definition, climate control, screening and modification of structural scale, such as feed mills. They are excellent for the control of dust, noise, odor and wind, especially when used in combination with other plant materials. Austrian pine, white pine, scotch pine and eastern red cedar are plant materials in this group, Figure 121.

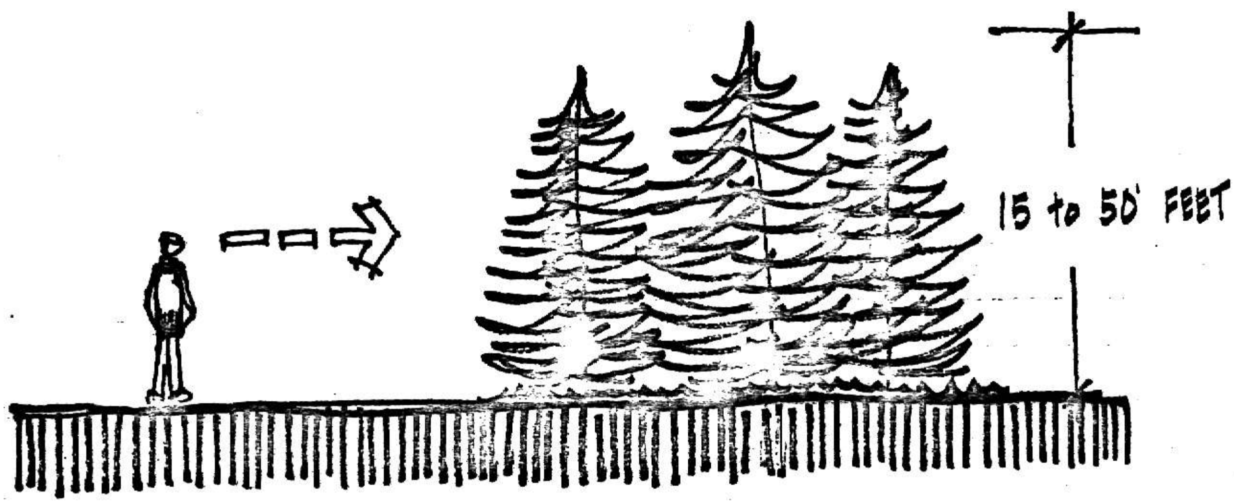

Figure 121. Large Evergreen Trees.

Large Deciduous Trees

Plant materials in this group can obtain heights up to 100 feet. They can provide shade as well as serving to minimize dust, odor and noise conditions. They are also very effective in spatial definition, view enframement and scale modification. Elm, hackberry, ash, red oak and honeylocust are examples in this group, Figure 122.

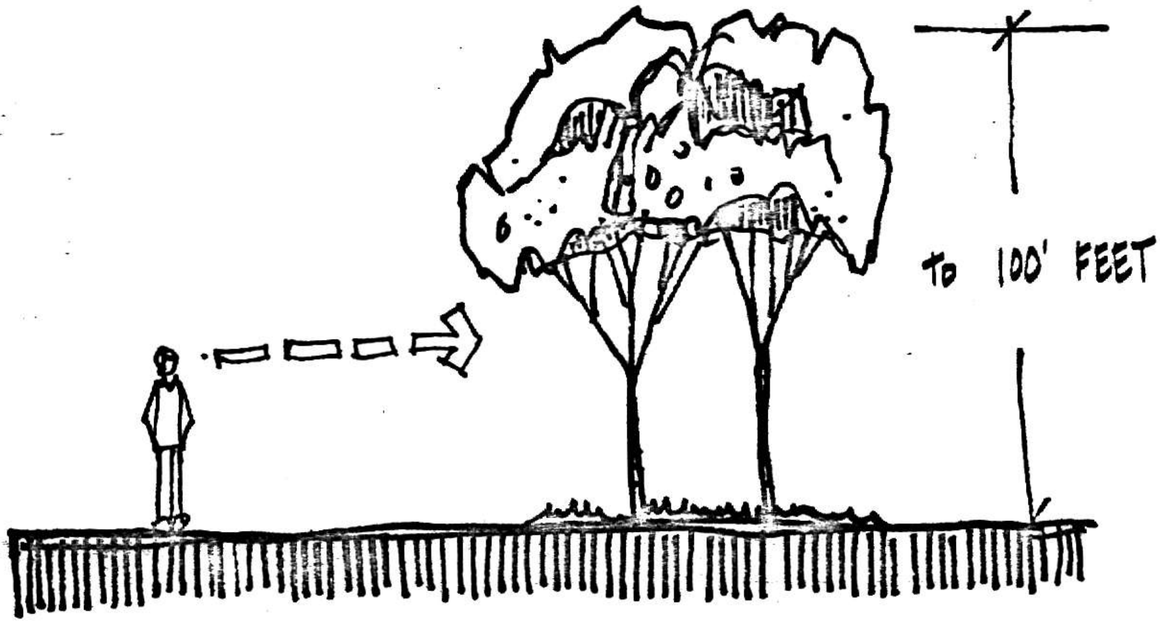

Figure 122. Large Deciduous Trees.

Professional Assistance

As with any profession or business, specific knowledge is necessary, for the successful operation of the enterprise. Feedlot owners and operators are not expected to be experts in the design, selection, care and maintenance of plant materials. Therefore, it is suggested, that the services of professional landscape architects, foresters and nurserymen be retained, to achieve the desired results. Local nurserymen and extension forestry services can provide plant lists and maintenance requirements of native and adaptable plant species. Specific design problems may require the services of professional landscape architects. For the most effective visual and environmental quality development, these professionals should be consulted, when existing feedlot sites are being rennovated, and when new feedlots are being planned.

CHAPTER 9

SITE DEVELOPMENT PLANS

FOR THE COMMERCIAL BEEF CATTLE FEEDLOT

The site planning process, for the development of the commercial beef cattle feedlot, consists of: 1) collection of data; 2) review and analysis of data; and 3) formulation of development plans; as mentioned in Chapter 2. This study has collected data, reviewed and analyzed the data for the formulation of the development plans.

Site development plans are generally composed of: 1) a regional location map, 2) site survey, 3) site analysis, 4) preliminary design plan, and 5) a master development plan. All of these plans are utilized to develop the commercial feedlot operation upon the landscape.

The regional location map, Figure 123, indicates the location of the commercial feedlot operation, in relationship to urban centers, highways, water courses and surrounding land. The ideal location for the commercial feedlot operation is in remote agricultural land, away from urban centers and water courses, but served by major arterial highways and good secondary roads. This type of location is essential in controlling nuisance problems.

The site survey, Figure 124, is necessary to determine property boundary lines, ownership of surrounding land, utilities and existing topography of the site. The site survey is generally conducted by a registered engineer, and serves as legal definition and description of the site property.

The site analysis, Figure 125, is conducted to determine the potentials of the site to accommodate the feedlot operation. Specific data, mentioned in Chapter 2, is also gathered as it concerns the site, to indicate site potential and limitations.

The preliminary design plan, Figure 126, indicates proposed land use and site organization, in the development of the commercial feedlot operation. The components of the feedlot operation are illustrated, in relationship to the site and each other. The preliminary design plan is also utilized to adapt necessary changes in site development. This plan is then used to prepare the master development plan.

The master development plan, Figure 127, illustrates the total feedlot operation, as it will appear when constructed on the site. Individual operational components, interior site roads, building structures, parking and plant materials are all shown to indicate the total development. This master plan, Figure 127, shows the ideal site organization of the commercial beef cattle feedlot operation, with perimeter 'buffer' zone development, interior site 'buffers', site entrance layout and manure disposal facilities incorporated for visual and environmental quality. An aerial perspective, Figure 128, provides an overall view of the commercial feedlot operation, as proposed in this study.

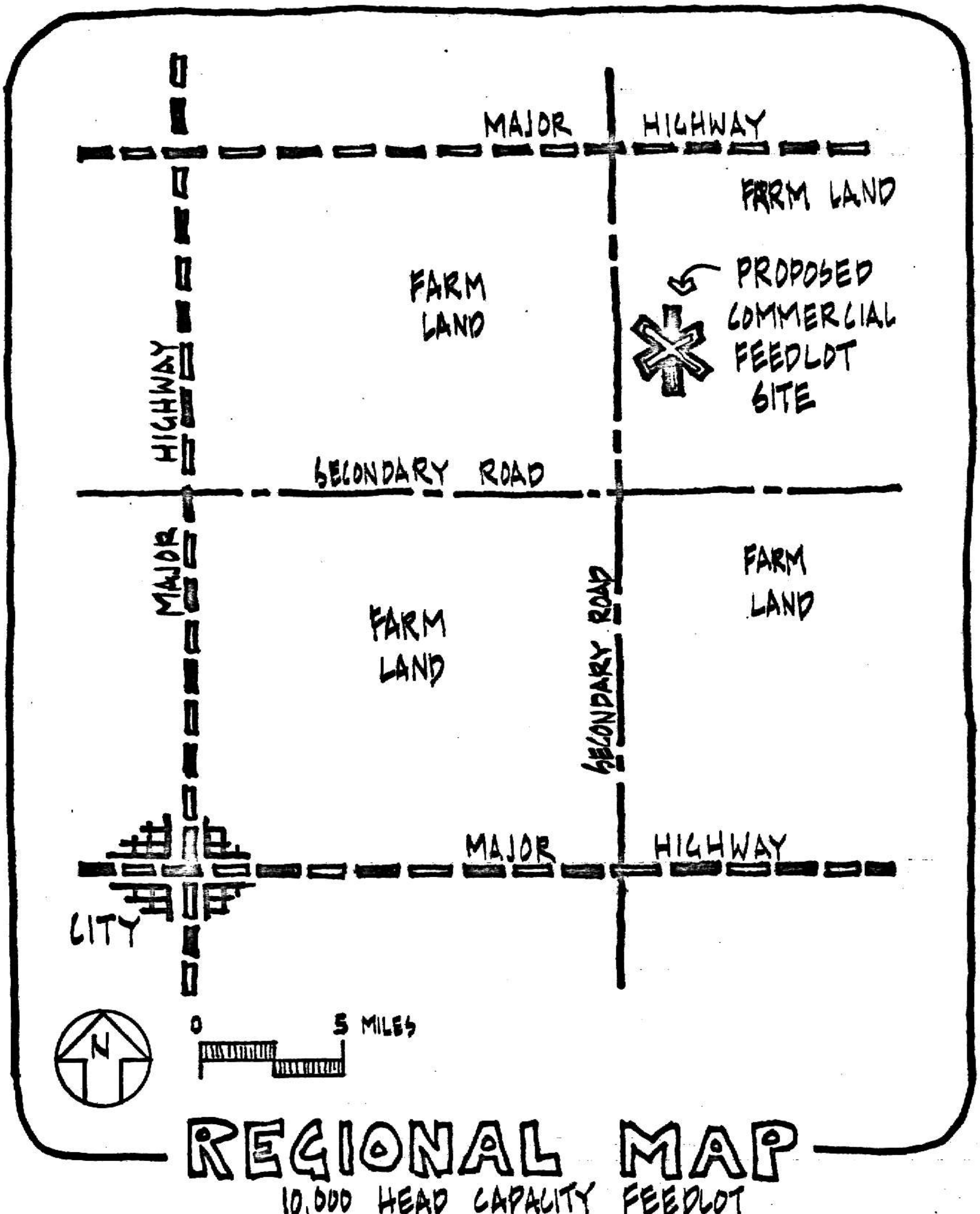
MAJOR HIGHWAY
FARM LAND
PROPOSED COMMERCIAL FEEDLOT SITE
FARM LAND
MAJOR HIGHWAY
SECONDARY ROAD
FARM LAND
FARM LAND
SECONDARY ROAD
MAJOR HIGHWAY
CITY
N
0
5 MILES
REGIONAL MAP
10,000 HEAD CAPACITY FEEDLOT

Figure 123.

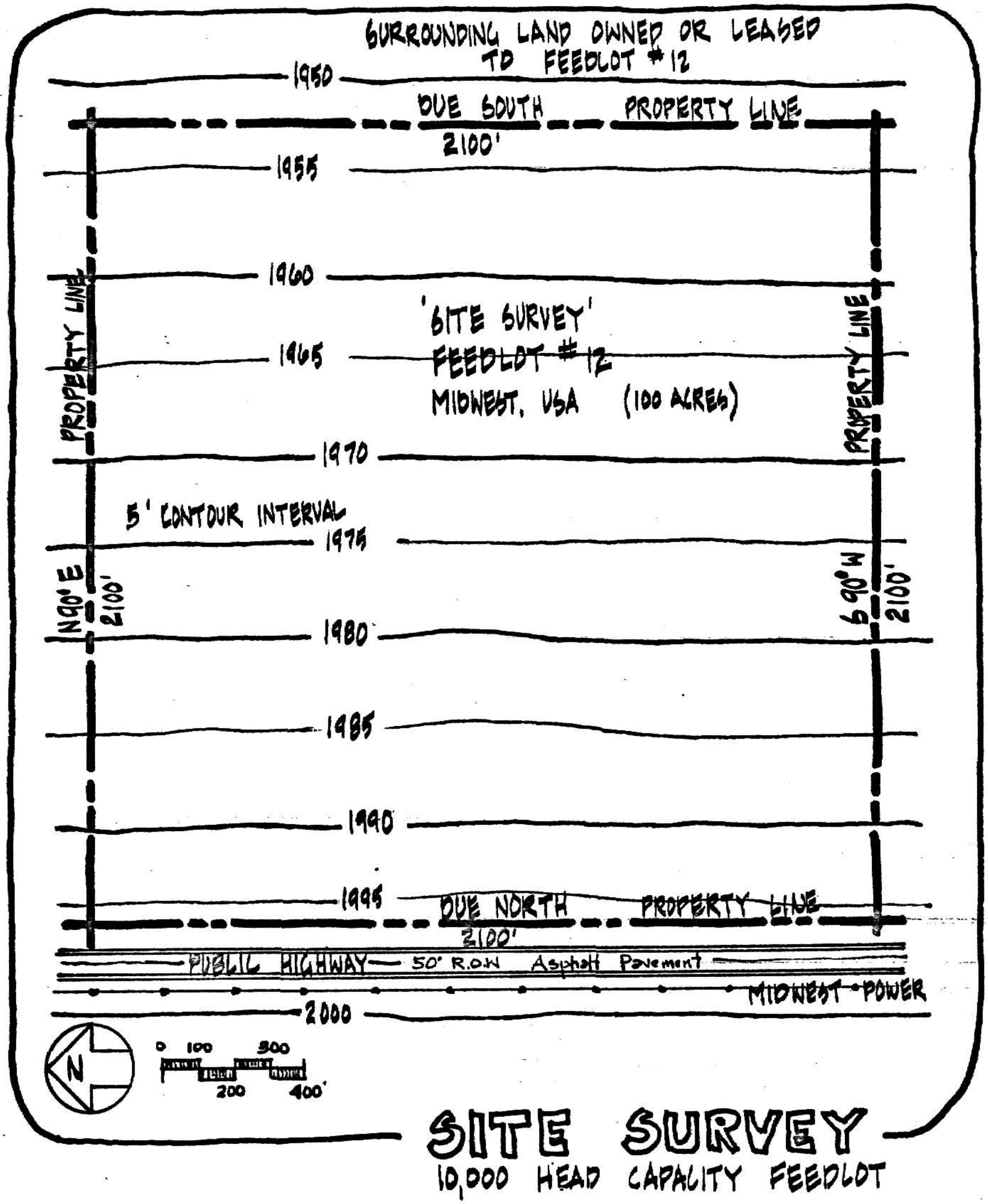
SURROUNDING LAND OWNED OR LEASED TO FEEDLOT # 12
1950
DUE SOUTH PROPERTY LINE
2100'
1955
1960
'SITE SURVEY'
FEEDLOT # 12
MIDWEST, USA (100 ACRES)
1965
PROPERTY LINE
PROPERTY LINE
1970
5' CONTOUR INTERVAL
1975
N90° E 2100'
S 90° W 2100'
1980
1985
1990
1995
DUE NORTH PROPERTY LINE
2100'
PUBLIC HIGHWAY 50' R.O.W Asphalt Pavement
MIDWEST POWER
2000
N
0 100 300
200 400'
SITE SURVEY
10,000 HEAD CAPACITY FEEDLOT

Figure 124.

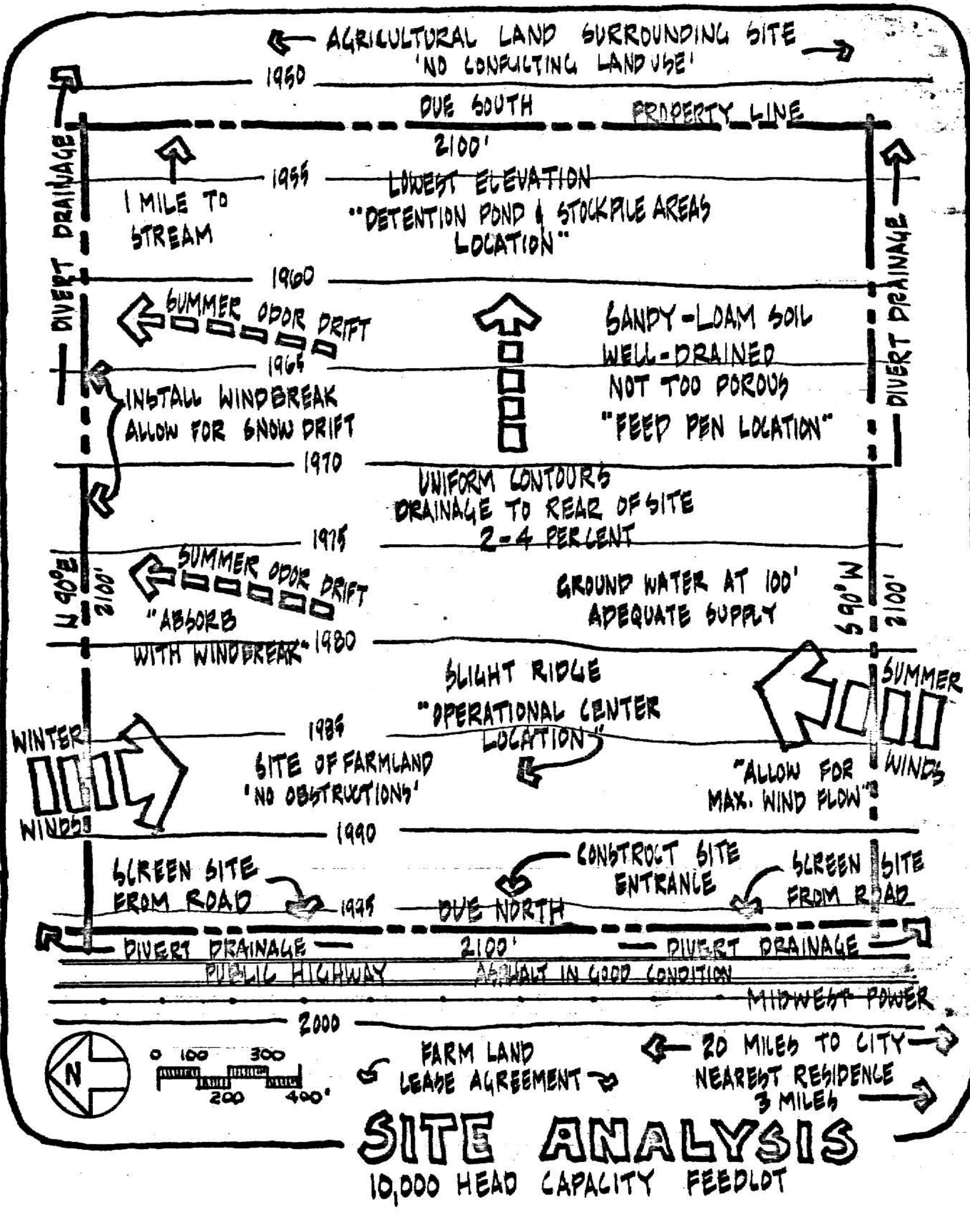
AGRICULTURAL LAND SURROUNDING SITE
'NO CONFLICTING LAND USE'
1950
DUE SOUTH
PROPERTY LINE
2100'
1955
LOWEST ELEVATION
"DETENTION POND & STOCKPILE AREAS
LOCATION"
1 MILE TO
STREAM
DIVERT DRAINAGE
DIVERT DRAINAGE
1960
SUMMER ODOR DRIFT
SANDY-LOAM SOIL
WELL-DRAINED
NOT TOO POROUS
"FEED PEN LOCATION"
1965
INSTALL WINDBREAK
ALLOW FOR SNOW DRIFT
1970
UNIFORM CONTOURS
DRAINAGE TO REAR OF SITE
2-4 PERCENT
1975
SUMMER ODOR DRIFT
"ABSORB
WITH WINDBREAK"
N 90°E
2100'
S 90°W
2100'
GROUND WATER AT 100'
ADEQUATE SUPPLY
1980
SLIGHT RIDGE
"OPERATIONAL CENTER
LOCATION"
SUMMER
WINDS
"ALLOW FOR
MAX. WIND FLOW"
WINTER
WINDS
1985
SITE OF FARMLAND
'NO OBSTRUCTIONS'
1990
SCREEN SITE
FROM ROAD
CONSTRUCT SITE
ENTRANCE
SCREEN SITE
FROM ROAD
1995
DUE NORTH
DIVERT DRAINAGE
2100'
DIVERT DRAINAGE
PUBLIC HIGHWAY
ASPHALT IN GOOD CONDITION
MIDWEST POWER
2000
N
0 100 300
200 400'
FARM LAND
LEASE AGREEMENT
20 MILES TO CITY
NEAREST RESIDENCE
3 MILES
SITE ANALYSIS
10,000 HEAD CAPACITY FEEDLOT

Figure 125.

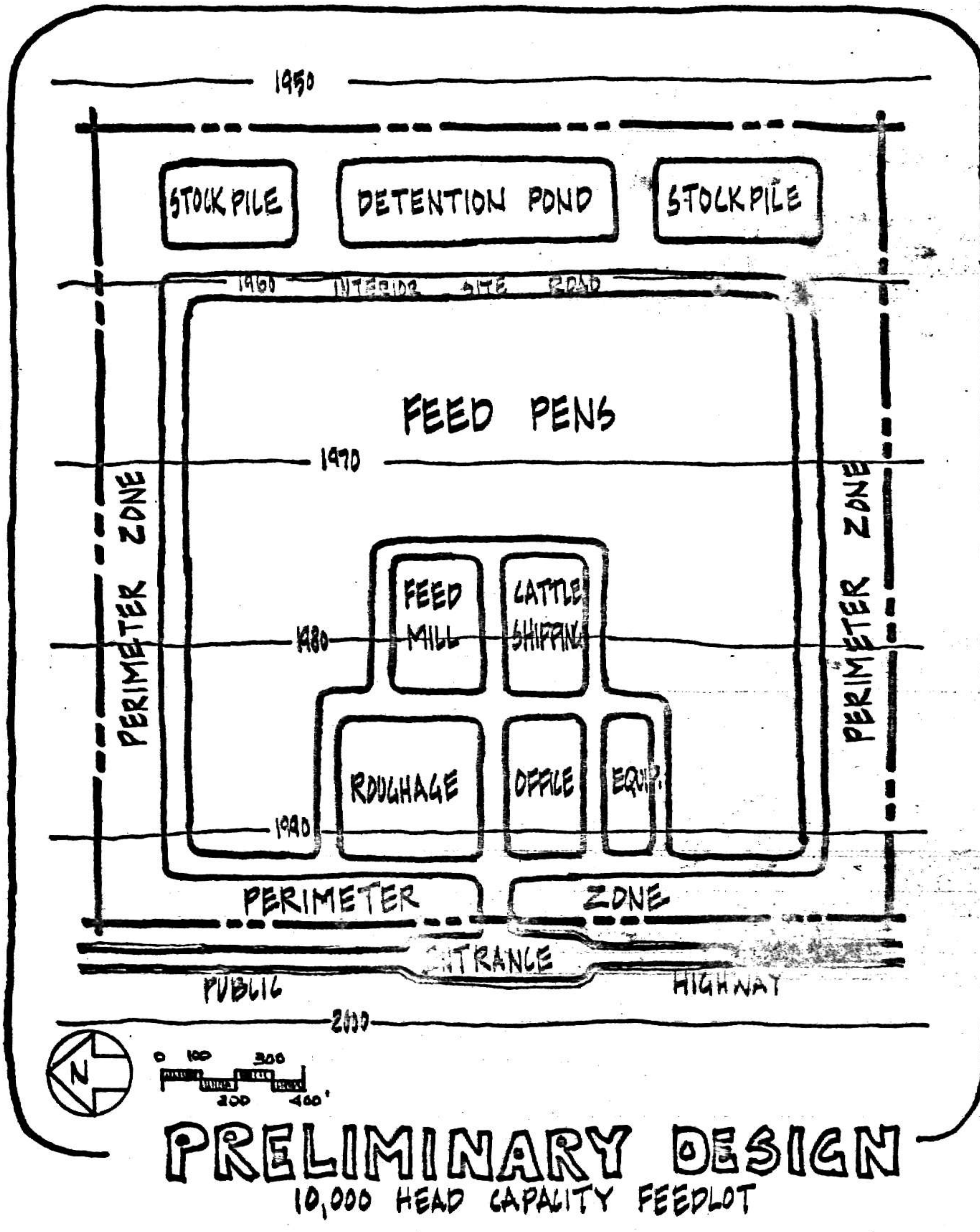
1950
STOCK PILE
DETENTION POND
STOCKPILE
1960
FEED PENS
1970
PERIMETER ZONE
FEED MILL
CATTLE SHIPPING
1980
PERIMETER ZONE
ROUGHAGE
OFFICE
EQUIP.
1990
PERIMETER
ZONE
ENTRANCE
PUBLIC
HIGHWAY
2000
N
0 100 300
200 400'
PRELIMINARY DESIGN
10,000 HEAD CAPACITY FEEDLOT

Figure 126.

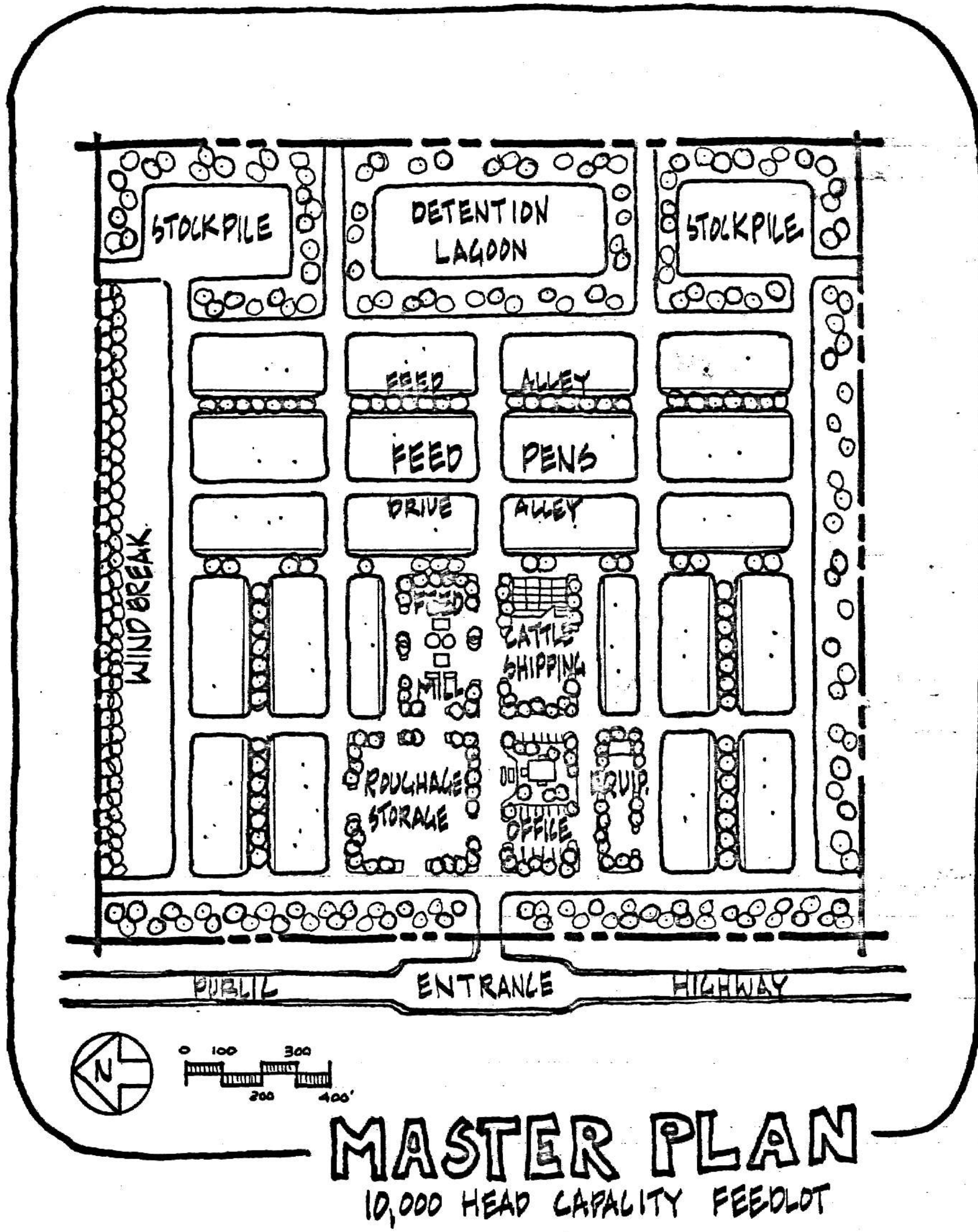
STOCKPILE
DETENTION LAGOON
STOCKPILE
WIND BREAK
FEED
ALLEY
FEED
PENS
DRIVE
ALLEY
FEED
MILL
CATTLE SHIPPING
ROUGHAGE STORAGE
OFFICE
EQUIP.
PUBLIC
ENTRANCE
HIGHWAY
N
0
100
200
300
400'
MASTER PLAN
10,000 HEAD CAPACITY FEEDLOT

Figure 127.

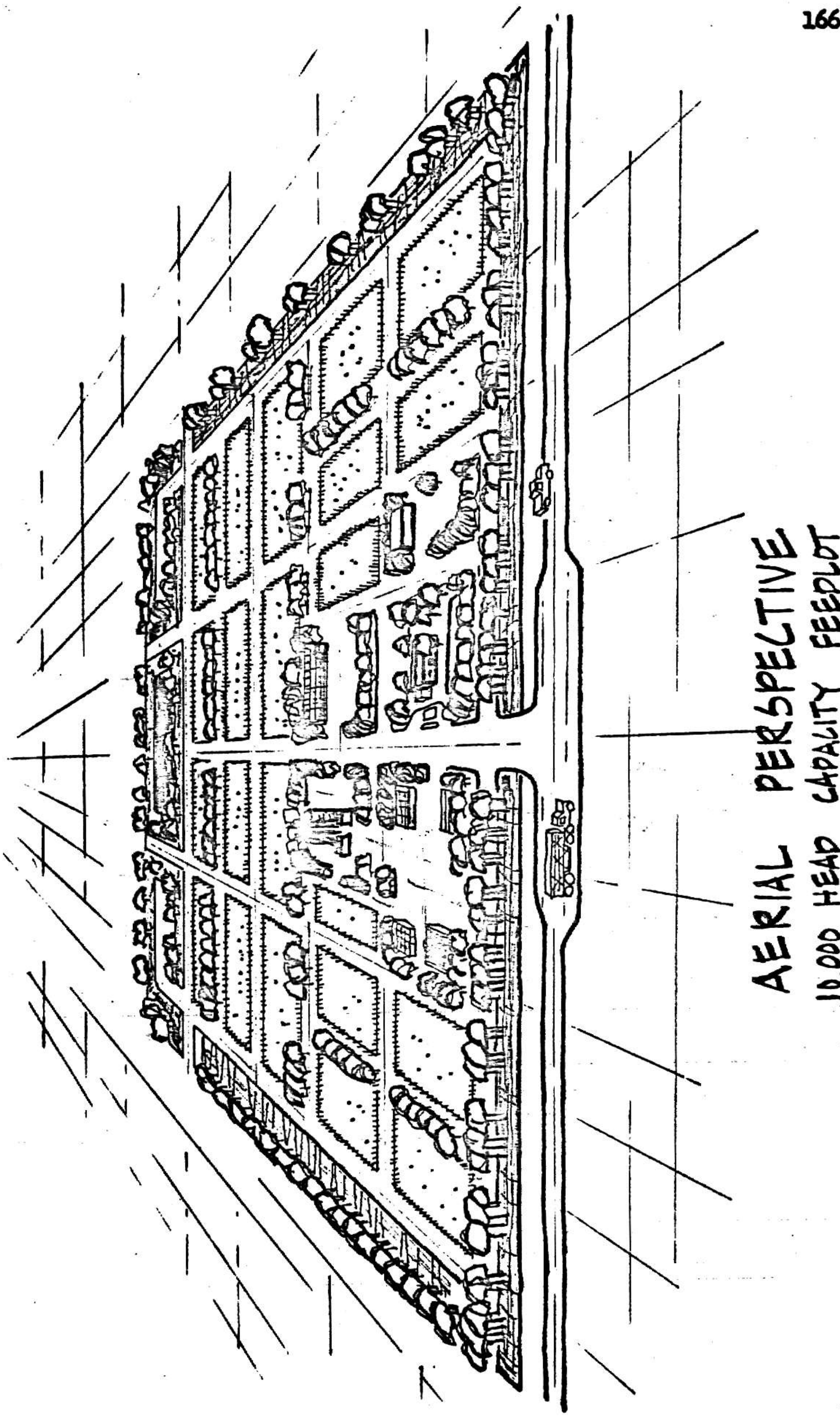

Figure 128.

CHAPTER 10

DEVELOPMENT COSTS

OF THE COMMERCIAL BEEF CATTLE FEEDLOT OPERATION

A prime consideration, for any proposed development, is the economics of construction. Development costs, for commercial feedlots, will, of course, vary, depending upon locale and proposed capacity. However, estimates can be determined, to provide and indication of costs.

Capital Investment

Based upon a 1970 study (35), capital investments for commercial feedlot operations, in Kansas, ranged from $431,500 for a 10,000 head capacity feedlot, to $1,016,000 for a 30,000 head capacity operation. The capital investment per head of capacity, will range from $43.15 for a 10,000 head capacity feedlot, to $33.87 for a 30,000 head capacity feedlot, Figure 129.

However, according to Robert Price (64), research assistant, Department of Economics, Kansas State University, economic inflation since 1970, has approximately doubled these capital investment costs, for the year 1976. Therefore, a 10,000 head capacity feedlot, in 1976, will require a capital investment of $863,000 or $86.30 per head of capacity. A 30,000 head capacity feedlot will require $2,032,000, or $67.73 per head of capacity. As these figures indicate, the cost per head of capacity, decreases, as the per head capacity of the feedlot increases.

The capital investment requirements, in Figure 129, do not include site planning and design concepts, as proposed in this study, to improve the visual and environmental quality of the feedlot operation. Such planning presents an additional capital investment cost. For purposes of determining additional capital investment costs, a 10,000 head capacity feedlot operation was selected.

CAPITAL INVESTMENTS FOR COMMERCIAL FEEDLOTS.

ITEM	5,000 head capacity	10,000 head capacity	15,000 head capacity	20,000 head capacity	30,000 head capacity
Feedmill:					
Steam-flaking	$100,000	$180,000	$250,000	$280,000	$ 350,000
Feedyards:					
a) Land	16,000 (80 acres)	32,000 (160 acres)	32,000 (160 acres)	64,000 (320 acres)	64,000 (320 acres)
b) Feedbunks and concrete aprons	30,000	60,000	90,000	120,000	180,000
c) Fences, water, sick pens, working and loading chutes, etc.	35,000	70,000	105,000	140,000	210,000
Total yards	81,000	162,000	227,000	324,000	454,000
Office: (equipped)	7,000	12,000	15,000	20,000	20,000
Shop: (equipped)	5,000	8,000	12,000	18,000	18,000
Trench Silos	9,000	18,000	27,000	36,000	54,000
Feeding and Main Equipment	31,500	51,500	67,000	98,000	120,000
TOTALS	$233,500	$431,500	$598,000	$776,000	$1,016,000
Per head capacity	$ 46.70	43.15	39.87	39.87	33.87

The above construction and equipment costs are provided solely as a planning guide. Construction costs will fluctuate widely due to variations in mills, kind and quantities of equipment, etc.

Figure 129. Capital Investments for Commercial Feedlots. (1970)

For purposes of comparison, Figure 29, in Chapter 7, illustrates a 10,000 head capacity feedlot operation, without visual and enviromental quality site planning. Figure 127, the master development plan, indicates a 10,000 head capacity feedlot operation, with such planning incorporated. The factors that contribute to additional capital investment costs are: 1) land, 2) land-forming, 3) plant materials and 4) other site improvements.

Land

The 10,000 head capacity feedlot, Figure 29, requires a land area of approximately 65 acres for feed pens, feed-drive alleys, feed mill, cattle shipping/receiving, roughage storage, equipment storage, administration and interior site roads. Liquid runoff detention and solid manure stockpile areas require an additional 12 acres of land. Total acreage for the feedlot operation is 77 acres, or 7.7 acres per 1000 head of capacity. These land requirements are within the recommended minimum standards for determining feedlot acreage (7 to 10 acres per 1,000 head of capacity).

The 10,000 head capacity feedlot, Figure 127, requires the same amount of land, 77 acres, for the facility. However, an additional 23 acres are required for perimeter 'buffer' zone development. The total acreage for this feedlot operation is 100 acres, or 10 acres per 1,000 head of capacity, which is, also, within the recommended standard for determing feedlot acreage. Therefore, perimeter 'buffer' zone development does not require additional land, if the standard of 10 acres per 1,000 head of capacity is used. For purposes of this study, the standard of 7 acres per 1,000 head of capacity, is utilized to obtain cost comparisons.

In determining the additional land cost, for the perimeter 'buffer' zone development, an average cost of $600-700 per acre is assessed. This cost is based upon the cost of unirrigated farm land in southwestern Kansas. (65)

The total additional land cost, for the perimeter 'buffer' zone development, is 23 acres X $650 or $14,950. The cost per head of capacity (10,000) is $1.49.

Land Forming

It is recommended, in this study, that land forming should be introduced into the development of the commercial feedlot site to provide visual screening, spatial definition, drainage control and improvement in visual appearance. Earth berms, suggested for the perimeter zone, have a variable height of 3 to 5 feet, maximum slopes of 3 to 1 and base widths of 25 to 50 feet. Land forming, in the perimeter zone, approaches 8000 linear feet. Utilizing the dimensions given, total earth work volumes are approximately 29,629 cubic yards. At a cost of $.75 per cubic yard (66), the total cost of land forming is $22,222 or $2.22 per head of capacity (10,000).

Land forming costs for the interior of the feedlot site are based upon berm heights of 3 to 5 feet, 3 to 1 slopes and base widths of 25 to 30 feet. The reduced width allows for maximum space within the operational center, without interfering with functional operations. It was noticed, during the field trips, Chapter 7, that adequate space was available, within most feedlot operations, for interior site land forming, therefore, additional land is not required.

Total land forming within the interior site approaches 5,075 linear feet. Earthwork volumes are approximately 11,277 cubic yards. At a cost of $.75 per cubic yard (66), the total cost is $8,458 or $.84 per head of capacity.

Total land forming costs, for the entire feedlot operation, is $30,680 or $3.07 per head of capacity (10,000). This cost is based upon a one-time cost, and not an annual basis.

Plant Materials

Plant material costs, for the commercial feedlot operation, are based upon the retail rate utilized by the Army Corps of Engineers, in developing recreation areas, within the state of Kansas (67). This method of cost assessment was selected on the basis of plant material quality and availability to provide instant effect, hardiness and fewer maintenance problems, when compared to seedling type plant materials. This retail rate includes the cost of the plant material, plus installation.

For clarification, in determining costs, plant materials for the commercial feedlot operation, are divided among the different use areas: 1) shelter or windbreak belt, 2) perimeter zone, 3) interior site and 4) feed alleys.

Shelter Belt

The shelter belt is composed of 5 rows of plant materials. Three rows are of eastern red cedar and/or pine, and two rows are of hackberry. Between row spacing is 20 feet and in-row spacing is 16 feet to 18 feet. The combined width of the shelter belt is 100 feet, with a linear length of 1,600 feet. The shelter belt requires a total of 478 trees. Plant materials costs, Figure 129, are $6,542.

Species	Condition	Height	Unit Price	Quantity	Total Cost
Red Cedar & Pine	BB	3-4'	$13.50	300	$4,050
Hackberry	BR	5-6'	14.00	178	2,492
	Total Shelter Belt Plant Materials Cost				$6,542

Figure 129. Shelter Belt Plant Materials Cost.

Perimeter 'Buffer' Zone

The remainder of the perimeter zone requires approximately 200 trees of such species as russian olive, redbud, red cedar, pine, honeylocust, hackberry and cottonwood. The total of 200 trees is divided into 20 per cent evergreen (cedar & pine), 40 per cent small deciduous (russian olive & redbud), and 40 per cent large deciduous trees (hackberry, honeylocust & cottonwood). Plant material costs, Figure 130, are $2,340.

Species	Condition	Height	Unit Price	Quantity	Total Cost
Small Deciduous	BR	5-6'	$ 9.50	80	$ 760
Large Deciduous	BR	5-6'	13.00	80	1,040
Evergreen	BB	3-4'	13.50	40	540
Total Perimeter Zone Plant Materials Cost					$2,340

Figure 130. Total Perimeter Zone Plant Materials Cost.

Interior Site/Operational Center

The interior of the feedlot site requires approximately 150 trees of different species. These trees are also divided into 20 per cent evergreen, 40 per cent small deciduous and 40 per cent large deciduous trees. Plant material costs, Figure 131, are $1,755.

Species	Condition	Height	Unit Price	Quantity	Total Cost
Small Deciduous	BR	5-6'	$ 9.50	60	$ 570
Large Deciduous	BR	5-6'	13.00	60	780
Evergreen	BB	3-4'	13.50	30	405
Total Interior Site/Operational Center Plant Materials Cost					$1,755

Figure 131. Total Interior Site/Operational Center Plant Materials Cost.

Feed Alleys

Plant materials for the feed alley are limited to one species, honeylocust, for reasons of hardiness, mature height and canopy structure. The total number of trees required for the feed alleys is 87, within the feed pen area. In-row spacing is 50 feet. Plant material costs, Figure 132, are $1,131.

Species	Condition	Height	Unit Price	Quantity	Total Cost
Honeylocust	BR	5-6'	$13.00	87	$1,131
Total Feed Alley Plant Materials Cost					$1,131

Figure 132. Total Feed Alley Plant Materials Cost.

Ground Covers

Ground covers such as crown vetch, bromegrass, ryegrass and buffalograss should be maintained in the perimeter zone as well as on earth berms, within the interior site. Costs will be different, depending upon the ground cover selected. Bromegrass is selected, for purposes of this study, as it can be utilized as a roughage feed for livestock.

Total acreage for seeding, within the feedlot site, is approximately 27 acres. Seeding rates for bromegrass are around 40 lbs. per acre. (68) Therefore, 1,000 lbs. of bromegrass seed in needed for total acreage coverage. At a cost of $.35 per lb. of seed (69), the total cost is $378. This cost is based on the current market price of bromegrass seed obtained from the Farmer's Coop, Manhattan, Kansas, April 1976. (69)

Other Site Improvements

Concrete curbing is recommended around the feed mill and weight scales areas, to control and direct traffic circulation, whild protecting adjacent planting areas. The linear distance of curbing is approximately 3,000 feet. At a cost of $3.50 per linear foot (70). the total cost is $11,500.

The entrance to the feedlot site is provided with acceleration and deceleration lanes to accommodate large truck traffic. These lanes present an additional cost of site improvement. The linear length of each lane is 200 feet, with a width of 12 feet. Total square yardage is 1,066. At a cost of $12.00 per square yard (71), including road shoulder widening and sub-base, the total cost is $12,792.

Interior site roads and other site details are considered the same for both commercial feedlot sites, in Figures 29 and 127. Therefore, additional costs are not incurred. The total cost of other site improvements is $24,292 as shown in Figure 133.

Item	Total Cost
Concrete Curbing	$11,500
Entrance Lanes	12,792
Total Other Site Improvements Cost	$24,292

Figure 133. Total Other Site Improvements Cost.

Total Additional Development Costs

The additional capital investment required for the 10,000 head capacity feedlot, as proposed in this study, is $81,068 as indicated by Figure 134.

Item	Total Cost
Additional Land (23 acres)	$14,950
Land Forming	30,680
Plant Materials	12,146
Other Site Improvements	24,292
Total Cost	$81,068

Figure 134. Total Additional Development Cost.

Total Capital Investment Requirements

Total capital investment requirements for the 10,000 head capacity feedlot, without visual and environmental quality planning, are $848,050 or $84.80 per head of capacity, Figure 135. Total capital investment requirement for the 10,000 head capacity feedlot, with visual and environmental quality planning is $929,118 or $92.91 per head of capacity, Figure 135.

The site planning techniques and design concepts, illustrated in this study, represent an additional capital investment of $81,068 or $8.11 per head of capacity for the 10,000 head capacity feedlot operations. This is based on a one-time cost and not an annual basis. These additional costs represent approximately 8.7 per cent of the total capital investment requirement.

Amortization of Capital Investment

Additional costs, represented by visual and environmental quality planning, decrease at the same rate as other capital investments, on a per head of capacity basis, when amortized on a yearly basis. A 10,000 head capacity feedlot, in one year will turnover 30,000 finished cattle for market (operating at 100 per cent capacity), based on an annual turnover rate of 3 times. Therefore, for complete amortization of the additional capital investment, in one year, the cost per head is $2.70. Amortization over a period of two years, represents a cost of $1.35 per head of capacity. Amortization over a period of three years represents a cost per head of $.90. Complete amortization of additional capital investment costs over a ten year period, represents a cost of $.27 per head of capacity, for a 10,000 head capacity feedlot. If capital investment requirements are borrowed, interest rates will tend to increase the cost per head, depending upon the rate of interest on loaned money.

Capital Investment Requirements and Comparisons for a 10,000 Head Capacity Commercial Feedlot Operation

Items	Total Cost	Cost per Head	% of Total
Feed Mill	$ 360,000	$ 36.00	38.8
Feedyards			
a. Land (77 acres)	50,050	5.00	5.4
b. Feedbunks & concrete aprons	120,000	12.00	13.0
c. Fences, water, sick pens, chutes & etc.	140,000	14.00	15.1
Total Feedyards	$ 310,050	$ 31.00	33.3
Office (equipped)	$ 24,000	$ 2.40	2.6
Shop (equipped)	16,000	1.60	1.7
Trench silos	36,000	3.60	3.9
Feed and Main Equipment	102,000	10.20	11.0
Totals	$ 848,050	$ 84.80	91.3
Site Planning & Development			
a. Land (23 acres)	$ 14,950	$ 1.50	1.6
b. Land Forming	30,680	3.07	3.3
c. Plant Materials	12,146	1.22	1.3
d. Other Improvements	24,292	2.42	2.5
Totals	$ 81,068	$ 8.11	8.7
TOTAL CAPITAL INVESTMENT	$ 929,118	$ 92.91	100.0

Figure 135.

According to McCoy and Price (72), average profits, for feedlot operations in Kansas, over a ten year period (May 1965 to Dec. 1974), were $9.55 per head of capacity. Based on this profit figure, the additional capital investment requirements, represented by visual and environmental quality planning, could have been absorbed and still yielded a profit to the feedlot operation of $9.28. These additional capital investment requirements represent approximately 2.8 per cent of the profits, over a ten year period.

Affect on Market Prices

The average wholesale price of a 1,100 lb. market weight, live slaughter steer, in the period, May 1965 to December 1974, was $31.46 per hundred weight or $346.06 per animal. (73) The additional capital investment of $.27 per head, over a ten year period, represents approximately 0.08 per cent of the average wholesale price of a market weight, live slaughter steer. This amounts to $0.00025 per lb. of weight. The average wholesale price of a pound of beef, in the period, May 1965 to December 1974, was $0.31. (73)

A 1,100 lb. live slaughter steer will yield a dressed carcass, approximately 60 per cent of live weight, or 660 lbs. The average retail price of a 660 lb. dressed carcass, in the period, May 1965 to December 1974, was $101.80 per hundred weight or $671.88. (74) The additional capital investment of $0.27 per head, represents approximately 0.04 per cent of the average retail price of a 660 lb. dressed carcass, or $0.00041 per lb. The average retail price of a pound of beef, in the period, May 1965 to December 1974, was $1.02. (73)

The dressed carcass of 660 lbs. must be cut and packaged for retailing, and will yield approximately 440 lbs. of retail meat cuts. Processing, transportation and marketing will add approximately $0.40 to the cost per pound, according to Duewer (75), Figure 136.

Item	Cost per Pound
Processing	$0.08
Transportation	.04
Labor	.21
Packaging	.05
Advertising	.02
Total	$0.40
Retail Price	$1.02
Total Retail Price	$1.42

Figure 136. Marketing Increases in the Cost of Beef.

The processed carcass of 440 lbs, at $1.42 per lb. represents a cost of $624.80. The additional capital investment cost of $0.27 per head, over a ten year period, comprises approximately 0.04 per cent of the total retail cost of a processed carcass. Additional capital investment costs represent approximately $0.00043 per pound of processed carcass.

These figures indicate that the additional capital investment cost, represented by visual and environmental quality site planning, will not substantially increase the retail price of beef. However, such site planning could possibly increase the amount of weight of the live slaughter steer, at the commercial feedlot operation.

Justification of Additional Capital Investment

The justification of additional capital investment costs are based upon improved environmental quality, public image, reduced 'nuisance' court actions and possible benefits, in terms of increased beef production (weight gains).

According to Paine (26), there is no one thing which a feedlot can do to be completely safe from 'nuisance' court action. However, good visual appearance may reduce possible lawsuits and convince a jury that there was no intentional, wrongful or unreasonable operation of the feedlot. If adequate facilities could reduce the nuisance level, their installation may be more economical than damages imposed by lawsuits. (26)

Paine (26) also points out that 'nuisance' court actions involve the 'weighing of interest' to each party. The court will attempt to reach the fairest possible action. However, with the emphasis presently on preserving environmental quality, the balance of interest, may be abandoned. The recent court settlement of the Spur Feedlot in Arizona, is a case in point. The feedlot was ordered to move, for the rights and interests of the public, but the urban developer was required, by the court, to pay for the moving cost. (26)

Additional weight is given this justification in the court actions (24):
'Spencer Creek Pollution Control Association versus Land Feedlots'. 1970

> This case was brought by an association of residents and land owners, against a cattle feedlot near Eugene, Oregon. The compliants were of surface water pollution, groundwater pollution, odors, spread of animal disease, unsightliniess, and insect and rodent infestation. The plaintiffs sought monetary damages and an injunction to preclude cattle raising on the property.
>
> The feedlot had a capacity for approximately 1,000 head and expansions were proposed to increase this to 1,500 head. The operation included the feeding of beet top silage, during a portion of the year, which contributed to odor and drainage problems.
>
> After length testimony and argument, the following orders were decreed:
>
> 1) Runoff of contaminated water was to be kept from the nearby creek.
>
> 2) No more than 600 head of cattle were to be maintained on the property.
>
> 3) The amount of beet silage to be fed was limited.

4) Continued efforts to reduce odor escape were required.

5) Damages were awarded to the various plaintiffs, in amounts ranging from $15 to $1,850.

Reference: Spencer Creek Pollution Control Association versus Organic Fertilizer Company, Case No. 96125. Circuit Court for the State of Oregon for Lane County. August 25, 1970.

'Edwards versus Black'. 1968. (24)

Mr. Black operated a commercial cattle feeding operation in a rural area near Audabon, Iowa. A group of 19 adjacent property owners charged that the offensive odors, flies and noise adversely affected their properties. The jury found that no nuisance existed in this case and declared the confinement operation was a reasonable use of property in that locality. The jury indicated:

1) The area in which the feedlots were located was primarily an agricultural area.

2) In spite of the numerous homes in the area, the feedlot was a reasonable use for that area.

3) The odors had not polluted the air in and around the plaintiffs properties.

4) The defendant had not used his property so as to endanger the health of the plaintiffs.

5) The operation and maintenance of the feedlot did not constitute a nuisance nor result in damages to the plaintiffs.

6) The operation of the feedlot did not constitute a continuing nuisance.

The decision was reached primarily on the basis of location. Although some consideration was given to distance from the residences as an element of location, the more important consideration was the character of the surrounding area. Thus, because the surrounding area was predominantly rural, the facility was judged as being properly located.

Reference: Iowa Law Review. 1971. "Ill blows the wind that profits nobody": Control of odors from Iowa livestock confinement facilities. 57(2) : 451-505. Edwards versus Black. Civil No. 15235-J28-170. (Iowa District Court, Montgomery County), November 5, 1968.

'Winnebago Company versus Flugel'. 1970. (24)

This case was heard by a judge in the Circuit Court, Winnebago County, Illinois, during 1969. Plaintiffs included the County of Winnebago and eight intervening plaintiffs, who were owners of property in close proximity (usually less than 1.0 mile) to the property owned by the defendant, D. A. Flugel.

A request for injunction was tried on two counts: (1) that the use of the Flugel property, as a cattle feedlot, was unlawful since it was contrary to the zoning ordinance; and (2) that the cattle feedlot was both a public and private nuisance because of odors, flies, other insects, bacteria in the air and nitrates in the groundwater that existed because of the feedlot operation.

The Flugel property was located in an area that had been classified as an 'agricultural district' in 1942. Flugel purchased the 24 acre property in 1969 and proceeded to construct a commercial feedlot. The completed feedlot was planned to confine about 2,800 head of livestock.

The feedlot area was graded from property line to property line, across the narrower width of the land tract. A portion of the area was concrete surfaced and sloped to drain to a sump in the center of the area. The sump drained to an earthern pit, through a corrugated metal pipe. Accumulated storm runoff was pumped from the pit and trucked from the Flugel property. The manure disposal plan was to truck the solid manure to a Wisconsin composting operation.

Having heard the testimony, the Court found that the defendant was operating a commercial feedlot in an 'agricultural use district' which the feedlot was not a stock farm, a domestic animal-breeding operation, or a use commonly classified as agricultural, but was found to be a stockyard or a use substantially similar to a stockyard as defined under 'Industrial Zoning'. There the defendant was found in violation of the zoning ordinance.

The Court's decree further found the feedlot to be a public nuisance because of the imminent danger of contaminating groundwater, of actual pollution of surface water which escaped to nearby properties, of the existence of offensive odors with no effective means to control or abate, and of substantially contributing to the fly population of the area. The feedlot was found a private nuisance as well. The defendant was permantly enjoined from using the premises as a cattle feedlot after March 1, 1970. An appeal was not perfected.

Reference: Winnebago County versus Flugel, Chancery No. G-19425. Illinois Circuit Court, Winnebago County, January 31, 1970.

As these court actions indicate, environmental and visual quality planning should be considered and implemented, in the development of the commercial beef cattle feedlot operation. Such planning can prevent public initiated court actions and enhance the public image of the feedlot industry. This study has shown that visual and environmental planning considerations are an integral aspect of site planning for commercial feedlot operations.

CONCLUSIONS OF STUDY

A review and analysis of the commercial feedlot industry indicates that confined feeding is presently the most favored method of finished beef production, and will continue into future years, remaining a permanent feature upon the landscape. Site planning techniques and design considerations are necessary to improve the visual quality, public image and surrounding environmental relationships of the commercial beef cattle feedlot industry.

Although such planning is, at the present time, not required by law, an environmentally conscious public could very well require it in the near future. It is unfortunate that existing conditions, of commercial feedlots, have created an unfavorable public image, when site planning techniques and design concepts are available to effectively minimize problem areas.

This study has shown that environmental protection and visual quality can be introduced into commercial feedlot facilities by utilizing: site organization, land forming, plant materials and site details; without interfering with functional operations. Such planning can be accomplished at a reasonable cost, as this study has also shown.

The application of these elements, to commercial feedlot operations, has been extensively illustrated. The preparation of this study does not, in itself, effectively solve the existing problems. However, it has taken the first step of research and adaptation. The final step, implementation, lies with the commercial feedlot industry. When that step is taken, this study will have served its ultimate purpose.

FURTHER STUDIES

Although research into plant material usage, selection and adaptation has been extensive in its relationship with man and environmental quality, the application to commercial finished beef cattle production is limited.

It is recommended that additional research be undertaken, at the university and industry levels, to provide more conclusive data and information. Specific areas of research should include:

1) Finished beef production as related to modified climatic conditions, induced by plant materials, within the feedlot site.

2) The determination of unforeseen problems and benefits generated by site planning techniques and design concepts, as illustrated in this study.

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SITE PLANNING FOR COMMERCIAL BEEF CATTLE FEEDLOT OPERATIONS

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Introduction

The commercial beef cattle feedlot industry began in the 1950's in the United States. This new method of mass, finished beef production evolved to meet the increased demand for beef as a food source for an ever growing population. The industry has grown very rapidly in the last 25 years, and will continue to be a permanent feature of the American landscape. The midwest and southwestern states are the principal beef producing areas, where abundant feed crops, suitable land and mild climates prevail.

Since the beginning of the commercial beef cattle feedlot concept, site planning and development has been approached from purely a functional aspect, with little concern given to environmental impact and visual quality. As a result, runoff water pollution problems and unslightly operations were created by poorly designed facilities, giving the industry an unfavorable public image.

The feedlot industry has, since the late 1960's, been required to meet federal, state and local environmental runoff pollution control regulations. Research by major universities and the cattle feeding industry has been extensive in the development of runoff water pollution control and waste manure management techniques. Unfortunately, the visual quality and public image of the commercial feedlot industry is still somewhat less than desirable.

Scope and Objectives of Study

The scope of this study involves a review of the growth and development of the commercial feedlot industry. Field trips into major finished beef

producing areas were undertaken to provide a thorough understanding of present feedlot conditions.

Existing feedlot site conditions and functional operations were studied to determine specific problem areas in site development, that contribute to unfavorable visual and environmental quality, as well as public image. Approximately 20 feedlot sites, old and new, were visited and a photographic record of existing conditions compiled. Personal interviews with the feedlot owners or managers were conducted to determine to what degree the feedlot industry is concerned with the environmental quality and public image of their operations. In almost all cases, there was a definite concern, however, active programs to improve these conditions were lacking. Reasons for this situation ranged from not having the knowledge to approach the problem, to it being an item of low priority, when compared to the functional aspects of the operation. Almost all of the feedlot owners and managers agreed that there is a definite need for such planning in the industry.

The purpose of this study has been to develop site planning techniques and design concepts, utilizing landscape architectural knowledge, that can be applied to commercial feedlot operations. Emphasis was placed upon the improvement of public image, visual quality and enhancement of the functional aspects of feedlot operations to create a harmonious relationship with the surrounding environment.

This study is not intended to be a technical journal on feedlot design. Nor was the purpose of this study a proposal of environmental pollution control regulations or alternative methods of waste manure management.

Site planning techniques and design concepts are illustrated in this study to provide the feedlot owner and manager with site development guidelines. This study has shown that visual and environmental quality can be incorporated into commercial feedlot operations by utilizing; site organization, land forming, plant materials and site detailing, without affecting the functional aspect. Such planning is also within economic feasibility for commercial feedlot operations.

Although this study does not, in itself, solve the existing problems it does indicate that the problem areas are capable of being minimized or eliminated.