Ministry of Agriculture and Rural Development Animal and Plant Health Regulatory Directorate

Construction Guideline 1

(for Phase I and II SPS certification facilities)

November, 2008
Addis Ababa,
Ethiopia

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List of acronyms

%	Percent
'	Foot
"	Inch
^{o}C	Degree Celsius
cm	Centimeter
e.g.	For example
EPA	Environment Protection Authority
ha	Hectare
hd	Head
i.e.	That is
ISU	Iowa State University
kg	Kilogram
l	Liter
m^2	Square meter
m^3	Cubic meter
m	Meter
mg	Milligram
mm	Millimeter
MoARD	Ministry of Agriculture and Rural Development
OIE	World Organization for Animal Health
SOPs	Standard Operating Procedures
SPS	Sanitary and Phytosanitary Standards
TDS	Total dissolved solids

Foreword

This technical document entitled "Construction Guideline 1, for Phase I and II SPS Certification Facilities" is one of the documents in a series of guidelines and Standard Operating Procedures (SOPs) developed by the Ministry of Agriculture and Rural Development (MoARD) in collaboration with the Ethiopian Sanitary and Phytosanitary and Livestock and Meat Marketing (SPS-LMM) Program. SPS-LMM program is financed by USAID and is implemented by the Norman Borlaug Institute for International Agriculture, Texas A&M University System. The main goal of the SPS-LMM program is to increase exports of meat and livestock to benefit Ethiopian livestock producers and exporters and to promote national economic development.

Considering the difficulties associated with disease eradication at national or zonal levels in Ethiopia, the Ethiopian Sanitary and Phytosanitary and Livestock and Meat Marketing (SPS-LMM) Program, in collaboration with MoARD, has developed a two phase SPS Certification system for safeguarding the export of Ethiopian meat and live animals from trade restricting animal diseases. To this background, the guideline and SOP is intended to assist the private and public involved in live animal and meat export in providing detail information on site selection, design, layout and construction requirements for Phase I and II SPS certification facilities.

The guideline and SOP includes criteria for site selection, layout and design, general and specific requirements for establishing Phase I and II SPS certification facilities which address the required bio-security and animal welfare issues of importing countries.

At this point, the Animal and Plant Health Regulatory Directorate (APHRD) would like to thank the SPS-LMM program and USAID for developing and publishing this guideline and SOP.

Last but not least, I would like also to thank Drs. Wondwosen Asfaw and Nega Tewolde for preparing this guideline and SOP.

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1. Background

In recent years, increased threats to human and animals from trans-boundary animal diseases have forced importing countries to apply more strict measures so that livestock and meat exported meet international SPS requirements. Based on this, Ethiopia is committed to meet SPS standards and expand exports of livestock and livestock products to prime markets in Middle East and North African countries.

To this background, the Ministry of Agriculture and Rural Development (MoARD) has proposed a two phase SPS certification system where by animals will be inspected, identified, tested, vaccinated and certified at different times and in different places, as they move from their point of purchase to export abattoir or port of embarkations. The proposed system identifies critical control points to intercept the possible transmission and spread of trade sensitive animal diseases along the export chain. The system is based on the OIE concept of "Compartmentalization" approaches where by compartments will be established based on strict management and bio-security procedures.

The present guideline is aimed at providing detail information on design, layout and construction requirements of Phase I and II SPS certification facilities.

2. Scopes of the guideline

The guideline applies to all new and existing holding grounds and feedlots in Ethiopia. Existing feedlots are also required to adopt technical, operational and management practices consistent with this guideline. The guideline refers to cattle, sheep and goat facilities used to hold and/or fatten animals. The guideline involves Phase I and II SPS certification facility layout, design and construction requirements for integrating each of the following standard components into a functional operating system, namely, feeding, watering, animal management, effluent and manure disposal, staffing, animal health care, etc.

3. Definition

Phase I SPS Certification Facilities: are small facilities with a maximum capacity of 200 heads of bulls and about 1000 heads of sheep and goats which are used to hold/quarantine animals. Depending on the requirements of importing countries, animals in these facilities will be inspected, identified, tested, vaccinated and certified as free from notify-able diseases of trade importance. These facilities will have common bio-security and management systems and contain animal subpopulations with distinct health status with respect to specific diseases for which required surveillance, control and bio-security measures have been applied for the purpose of international trade.

Phase II SPS Certification Facilities: are relatively large and well managed feedlots for cattle which are under strict bio-security and management systems. These facilities should receive animals (cattle) from Phase I SPS facilities. The facilities may contain a maximum of 5,000 heads of cattle which have distinct health status with respect to a specific disease(s) for which required surveillance, control and bio-security measures have been applied for the purpose of international trade. Cattle will remain in these facilities as long as it takes to reach export quality of animals.

When constructing Phase I and II SPS facilities, due consideration should be provided to the following issues.

4. Site selection

Many factors must be considered when selecting a site for the establishment of Phase I and II SPS facilities. Intelligent and well thought location greatly improves the economic, environmental, bio-security and animal welfare issues and ensures long term viability, security and sustainability of the business. Where possible, the site should be selected so that the need for costly engineering works and environmental protection measures are avoided and community amenity is not adversely affected. Finding a site that completely satisfies all the site selection criteria is not easy. While the selection of a site with one or more unfavorable characteristics is not encouraged, it is recognized that some site disadvantages can be minimized by appropriate engineering works or superior management practices. Where such a site is chosen, environmental performance should be closely monitored.

4.1. Issues to be considered

- Bio-security considerations to prevent disease transmission and spread.
- Economic viability issues, such as proximity to feed and livestock supplies.
- Infrastructure support issues such as access to roads and water sources.
- Suitability of climate for easy operation of facilities without the provision of expensive protection measures (e.g. large effluent ponds in high rainfall areas).
- Site features such as suitable topography and availability of suitable construction materials.
- Environmental impact issues such as the protection of water quality and protection of community amenity.
- Distance between the site and human habitation, non-compatible industries, etc.
- Available land resources (on and/or off site) capable of utilizing the effluent and manure from the facilities.
- Animal welfare issues such as minimization of heat stress in livestock.

To gain an adequate knowledge of the natural and man made attributes of a possible Phase I and II SPS site, the following sources of information should be consulted in the initial stages of the design and planning process.

- Aerial photos.
- Cadastral and topographic maps.
- Soils and land capability maps, soil conservation plans and layouts.
- Geological maps.
- Hydro-geological data, e.g. availability of water, previous groundwater studies, etc.
- Climatic data.
- Federal and Regional Government guidelines and regulations.

4.2. Site selection criteria

The following sections outline specific criteria for selecting sites for the establishment of Phase I and II SPS facilities. The items are not listed in any order of priority, as it is the combination of all site selection criteria that determines the suitability of a particular site.

4.2.1. Geographic location

To be economically viable, both Phase I and II facilities must be located close to supplies of fodder, grain, other feedstuffs, cattle, labour and abattoirs and have all weather access roads. Proximity to grain supplies is the major consideration when establishing Phase II SPS facility.

4.2.2. Climate

Climatic conditions have an impact on the environment, performance of animals and their welfares. Most environmental problems are associated with wet conditions (odour and runoff). For this reason, sites with a high annual moisture deficit are desirable (i.e. average annual evaporation exceeds the average annual rainfall by a considerable margin; e.g. if the average annual rainfall is less than 750 mm, the average annual pan evaporation needs to exceed 1500 mm). Design and management changes can be adopted for sites with high rainfall. Facilities established in these areas often require the construction of higher capacity drains, sedimentation systems and holding ponds. Larger effluent utilisation areas are also often required. Higher standards of pen foundation construction may be required to ensure durability in these wetter climates. Cattle can be finished in a wide range of climates. However, productivity decreases as the environmental temperature increases to above 35^{o}C. If sites are selected where high temperatures persist for prolonged periods, the provision of shade should be considered. The breed and finish condition of cattle being fed may also determine the need for shade at a particular site.

4.2.3. Topography

It is desirable, but not essential, that the feed yard area has a natural slope of 2% to 6%. For sites with fewer slopes, earthworks can be undertaken to create slope in the yards. Yard slopes greater than 6% are undesirable due to the excessive manure movement from the yards during rainfall and possible erosion of the manure-soil interface. Similarly, yard slopes less than 2% are also undesirable due to the slow drying of manure and little drainage from yards during and after rainfall. It is generally undesirable for facilities to be established on hillsides above residences or towns due to the potential for odour nuisance. This is particularly an issue if the down-hill air movement can be concentrated or confined by valley walls. As a general rule, offensive odours are less likely to be detected at residences situated at a higher elevation than the facility.

4.2.4. Risk of disease transmission

The risk factors for infectious diseases are mainly related to the environment that puts them into contact with the disease agent. As a result, Phase I and II SPS facilities should be established away from high livestock density areas, human habitations, game reserves, livestock trekking routes and markets.

4.2.5. Pens

A soil with 25 percent or more clay is preferred to sand or fractured rock structures. It is desirable to locate the pen area on a compacted, smooth, well-drained site. Hence, the following areas are not suitable.

- Rocky areas.
- Areas where natural springs occur.
- Areas with light sandy soils.
- Areas with highly expansive heavy clays overlying shallow groundwater aquifers.

4.2.6. Sedimentation systems, holding ponds, drains, manure stockpile and composting areas

A site must be available where sedimentation systems and holding ponds can be economically constructed and will fill by natural drainage from the facility yard area. The soils underlying the ponds, drains, manure stockpile and composting areas should have a sufficient clay content to ensure that they are not permeable. If the available soil types are not suitable, imported clay or synthetic liners may be used.

4.2.7. Effluent utilisation area

Productive agricultural soils are required for the long term application of water, nutrients, salts and organic loads in the effluent. These soils should preferably be deep, free draining and should not be overloaded with nutrients or salts. Ideally, the effluent application area should be close to the holding ponds. The best agricultural soils should be set aside for this purpose. Inferior soils can be used, but lower productivity means lower application rates and more land area required. The availability of clean irrigation water for effluent dilution and supplementary irrigation enhances the productivity of effluent irrigation schemes. The lack of good soil for effluent irrigation cannot be overcome by engineering works or the importation of material. Hence, this is an important aspect of site selection.

4.2.8. Manure utilisation area

Manure can be economically spread over a much wider area than the liquid effluent. Nevertheless, manure spreading area must not be too far from the facility premise. Most soils will benefit from the well managed application of manure. The actual application rate should be determined after analyses of both the soil and the manure, in light of the proposed cropping program. The addition of inorganic fertilisers to balance nutrients is often required. Most soils suitable for cropping or pasture production will be suitable for manure spreading, provided sufficient area is available.

4.2.9. Infrastructure and staff

i) Access

The site must be selected so that there is suitable access. Consideration should be given to the preferred routes for vehicles entering and leaving the facility. Permanent all-weather access is required and should not be limited by flooding or other similar occurrences.

ii) Water supply

Phase I and II SPS facilities require a continuous supply of good quality water for uses such as drinking water (animals, staff), dilution of effluent water for irrigation, dust control, fire control and feed preparation. The volume of water required will depend on animal numbers and weights, local climate, irrigation requirements and feed preparation requirements. Hence, an individual estimate is required for each site. When assessing the suitability of a water supply, it is necessary to determine total annual requirements, peak short-term flow rates and emergency reserves in case of supply breakdowns. Bores provide a constant source of water provided that the quality is suitable. When selecting a site, consultation with the Federal and Regional water resource authorities is necessary to ensure that it is possible to obtain adequate supply of water at that site. Water quality should be analysed as part of the site selection process. Some water may be unsuitable for stock consumption. As excess salt passes through a beast, a salty drinking water results in salty runoff from animal yards. Consequently, the resulting effluent may be undesirable for long term irrigation.

iii) Land requirements

When selecting a site for Phase I and II SPS facilities, it is essential to ensure that there is sufficient land available. Land is required for feed yards, feed handling and storage facilities, animal handling yards, isolation pens, water storage and tanks, manure stockpiles, ponds, effluent and manure utilisation areas, roadways, animal lanes and drains, carcase disposal areas and buffer zones. Buffer zones include, double fences, tree belts and windbreaks around the facility yards, screens or tree belts to visually screen them from the public and buffer strips between land utilisation areas and water courses. The total area required will depend on animal numbers and size, methods of waste utilisation, local climate, soil types and topography, cropping programs and availability of existing buffer zones. The area required for waste utilisation will depend on whether the material is to be used on or off site, the soil type and cropping program. It is often not economically feasible to export liquid effluent off-site, because of transportation costs. Consequently, it is generally necessary to have sufficient land area available on the facility property to utilise the liquid effluent produced by the facilities. In the case of manure, it is desirable for facilities to have some productive dry land or irrigated cropping or pastures areas available for application.

As a rough rule of thumb, it is desirable to plan for

- 40 ha per 1000 head (250 hd/ha) for yards and associated facilities.
- 100 ha per 1000 head (10 hd/ha) for manure and effluent utilization on productive cropping land.

The provision of adequate land for all present and future facility activities is an essential part of site selection. Insufficient land availability is the cause of many problems and is very difficult to overcome. Insufficient land may also limit future expansion of the facility.

iv) Staff

While it is necessary to locate the Phase I and II SPS facilities away from residential areas so as to maintain community amenity and bio-security, it is also undesirable to locate them in an extremely remote area. In such instances, availability of manpower may be a problem.

4.2.10. Surface waters

i) Flooding

Pens, manure stockpiles, effluent irrigation areas, sedimentation basins and holding ponds should not be located in flood prone areas unless adequate safeguards are incorporated. In some cases, levee banks may provide the necessary protection. Consideration should also be given to vehicle access to the site during periods of prolonged flooding.

ii) Protection of surface water quality

The facilities should be sited, designed and managed so that the quality of surface waters in the vicinity are not degraded by runoff, leaching or seepage from the facility yards, ponds or waste utilisation areas. To achieve this, a reasonable buffer should be provided between the facility complex (including waste utilisation areas) and streams, rivers and other watercourses. The separation distance chosen should be a function of the intervening topography, vegetation, natural gradient, management practices employed by the facility operation and other site specific factors. Effluent utilisation areas should be sited so that irrigation spray drift or direct runoff of applied effluent does not enter a watercourse.

iii) Protection of groundwater quality

Phase I and II SPS facilities should be sited, designed and managed so that the quality of groundwater is not degraded by the movement of pollutants or pathogens into the water resource. To achieve this, facilities should not be sited above ground water recharge areas or above ground water resources that are deemed to be vulnerable, unless those resources can be demonstrably protected. Such protection may be provided by one or more impervious geological strata and/or because the water is at considerable depth. Clay or synthetic lining may also provide protection.

Sites to be avoided include those

- ❒ where there are existing shallow or rising water tables.
- ❒ where there are shallow perched water tables.
- ❒ where useable underground water resources are already partially degraded; or
- ❒ where there are major faults that might provide a short circuit for pollutants to the groundwater resource.

Waste utilisation areas should be sited away from bores and wells. Effluent or manure should not be applied within 25 m of a bore or well which is used for domestic consumption.

4.2.11. Community amenity

Even with the best design and operational practices presently available, it is not possible to prevent entirely the generation of odour, dust and noise by these facilities. Therefore, to protect community amenity, facilities should be established at an appropriate separation distance from sensitive community receptors. Following the development of the facility, local authorities should discourage the establishment of new receptors within the previously determined separation zone, wherever possible. The desirable separation distance between the point of generation of the odour and each sensitive receptor will be a function of the source and intensity of the odour, the prevailing meteorological conditions at the site, and the nature of the intervening terrain and vegetation. Odour intensity will itself be a function of the climatic conditions, facility capacity, stocking density, and design, construction and management practices. Wherever possible, it is desirable to utilise existing topography and vegetation to screen new facility developments from roads, towns and nearby residences. The value of these natural features as buffers against odour, dust and noise and as wildlife habitats should be utilised wherever possible.

4.2.12. Sites contaminated by pesticides

It is generally desirable to locate Phase I and II SPS facilities away from yards that are contaminated with pesticides. Soil testing may be required to determine if there is a residue problem. Local authorities also maintain registers of contaminated sites. These should be consulted if there is any doubt about a site.

5. Layout and design

The following general principles should be followed when considering the layout and design of Phase I and II SPS facilities.

- ❒ Receiving, induction, dispatch and isolation yards, manure stockpile areas and (preferably) feed storage areas should be included in the facilities controlled drainage area. Runoff from this area should be treated and collected in the sedimentation and retention pond system.
- ❒ The size of the controlled drainage area should be kept to a minimum by diverting any runoff from areas that have not been affected by manure, away from the site. This will minimize the required pond sizes and effluent utilization areas.
- ❒ Pen to pen drainage should be avoided by ensuring that the pen cross-slope is less than the slope towards the below-pen drain.
- ❒ Staged development/future expansion should be catered for.
- ❒ Any existing topographic features or vegetated areas should be utilized wherever possible to screen the facilities from the public and/or neighboring landholders.
- ❒ The facilities should be located in sites that can be possible to ensure bio-security measures (e. g. away from high livestock density and human habitation, wild game reserve areas, livestock trekking/transporting route and market areas).
- ❒ The layout for both Phase I and II facilities should be shown with an explanation. Landscaping and grading of these facilities should consist of general site grading and detailed grading in the pens and road areas in order to direct water toward the runoff retention area.

- The overall area of these facilities should be graded at a minimum 0.5% slope toward the runoff retention area.
- Pens where required should be graded at a 2% slope toward the rear of the pen and subsequently into the drain alley.
- Cattle alleys should be sloped at 2% toward the drain alley.
- The drain alley center line should be sloped at 0.5% toward the runoff retention area.
- Feed and inspector alleys should be constructed with a negative crown of 2% to the middle of the alley.
- The center line of the feed alleys should be sloped at 0.5% toward the runoff retention area.
- There should be a perimeter interceptor ditch around the facilities, sloped at 0.5% toward the retention area.

6. Blue prints (plans and specifications)

An architect, engineer, or other person should be employed to prepare drawings and specifications. Drawings must be scaled to not less than 1:100, except for the "Site Plan".

- ❒ Drawings must have a title block providing the legal address of the establishment, date, designing company name, the scale, and the compass North point.
- ❒ The "Site Plan" shall show the entire premises. It must include:

    - The boundaries of the plant property,
    - Location of all section and location of the plant in respect to other structures in the surrounding,
    - Loading and unloading areas,
    - Receiving pens,
    - Inspection crush,
    - Pens with their partitioning,
    - Alleys,
    - Locations of foot baths,
    - Feed and water troughs,
    - Shades,
    - Feed store,
    - Offices,
    - Sick pen,
    - Recovery pens,
    - Emergency slaughter,
    - Gates and doors,
    - Fences, fence types, internal and external and their distances,
    - Potable water sources (wells, dams, rivers, lakes, reservoirs, etc),
    - The route of water and sewer lines and drainage systems,
    - Surfacing materials e.g. packed earth etc.
    - Roads,
    - Effluent treatment sites,
    - Neighboring businesses,
    - power lines,

- Relationship of all the different levels of the establishment e.g. receiving, pens, effluent, etc,
- The limits of the official premises.

❒ A floor plan showing

- The purpose for which each area is going to be used,
- Holding capacities of facility/pens,
- Location and size of floor drains,
- Gutters and slope of floor towards drains,
- Location of fences, partitions, gates, posts,
- The elevations of the fences,
- Flow of animals,
- Employee traffic in the facility.

❒ A cross section of the facilities showing

- Fence, shade, office ceiling, walls, feed and water troughs, crushes, loading and unloading ramps and feed store heights,

❒ Plumbing plan(s) shall show

- The location of all sewage lines (including their sizes), hand wash facilities, toilets, floor drains (including their size and connections),
- Gutters, slope of floors towards drains,
- Water storage tanks (if applicable including location, size and construction material).

7. General requirements

7.1. Feed supply

Feed is a key to profitable animal raising. Animals need food nutrients for maintenance, growth and production. The animal feeder must formulate feeds based on his animals' species, sex, age, weight gain desired and the moisture content of available roughage and feeds.

❒ When setting, particularly, Phase II facilities, due considerations should be given to the availability of feed in the locality.
❒ The feed ration should be adjusted to the requirements for fattening cattle based on the availability of feed materials in the locality. It is best to restrict animal movement at all times, so that it uses less energy and gains weight quickly.

7.2. Water supply

Lack of water reduces feed intake and causes stress on animals. Animals must have access to an adequate supply of cool, clean, suitable quality, drinking water.

- As a guide to drinking water requirements, a 400 kg animal requires about 35 L/day in cold weather and 70 L/day in hot weather. Over a year, an average of 5 L per 50 kg live weight per day is reasonable for planning annual consumption.
- In addition, where water is required for dust control, an additional application of 5 liters plus 2 liters per day may be required per square meter of pen floor. In very dry conditions, 15 liters per square meter is recommended every 10 days. This is an extra requirement of 22.5 liters per animal per day at normal stocking densities. Care must be taken to ensure water application for dust control does not cause wet spots and increase odor.
- Daily requirements for water therefore approach a maximum of 100 liters per day during hot weather. This amount must be able to be delivered to the pens over an 8 hour period.
- Cattle are reasonably tolerant to water with high levels of salts. They can tolerate up to 10,000 mg/l TDS for limited periods, but the recommended maximum for growth is 5,000 mg/l TDS. Generally the higher the salinity of drinking water, the higher will be the salinity of the feedlot effluent and manure, which can create problems with its safe utilization.

7.3. Drains

- Adequate drainage must be available throughout the establishments.
- Drains should be located outside main drive alleys, chutes and crowd pens.
- The floor of pens should be made in such a manner that effluent including manure runs off at the lowest point down the stock lanes between the pens and channeled into broad drains and ultimately into anaerobic ponds or evaporation ponds.
- Drains must be lined with material of sufficiently low permeability to minimize the potential for leaching of contaminants into the soil or underground water resources.
- They must have sufficient flow capacity to avoid overtopping.
- They must be free flowing to avoid excessive sediment build up. They must be easy to maintain them in a clean weed free condition.
- They must have sufficient bed gradient to effectively convey suspended sediments to the sedimentation system without excessive scouring of the drain bed. Flow velocities will be affected by the drain cross section profile, dimensions, slope and drain bed material. Maximum permissible flow velocities to prevent scouring will depend on the drain bed material.

7.4. Floors

The adoption of a suitable floor slope is essential for ensuring good drainage. By ensuring that the floors dry out rapidly after rainfall, odor generation is minimized and animals are not subjected to boggy conditions, which could adversely affect their health, welfare and performance in the facilities. Slopes are often described as percentages, for example a 3% slope is a uniform fall (or rise) of 3 meters over a horizontal distance of 100 meters. The pen slope may utilize the natural slope of the site, or the slope may be artificially constructed.

- The flooring of Phase I and II facilities should be graded and can include compacted soil, limestone outcrops or ridges or a compressed rubble base.
- The floor slope should be in the range of 2 to 6% with 3% considered optimal in order to facilitate drainage and minimize erosion.
- The pen floor should have a slope of between 2 – 6% away from the feed bunks.

7.5. Stocking density

The stocking density is generally defined as the average facility pen area allocated to each animal. It can influence the performances of animals in addition to their general health and welfare. Furthermore, it has important implications for the environmental management of the facilities, as it affects the moisture content of the pad and therefore its potential to produce odor and dust.

- ❒ Stocking densities should take into account the local climate and the size of cattle in the feedlot.
- ❒ There needs to be a compromise between the higher odor generation potential at heavier stocking densities and the higher incidence of dust problems at lighter densities.
- ❒ In general, a range of 9 to 25 m^2/head is recommended.

8. Specific requirements

8.1. Receiving pen

- ❒ Phase I and II facilities should have receiving pen to allow 23 m^2 per head to avoid crowding and ensure proper inspection of animals.
- ❒ Trucks and stock trailers must have easy access to the gates of receiving pens.
- ❒ There should be a circular turning area to the backing of trucks and trailers. Allowing a semi-truck to enter and circle back out the entrance road requires a turning area of 40 to 46 meter in diameter.
- ❒ The facility should be located outside the establishment areas to accommodate large trucks.

8.2. Inspection crush

In order to precisely inspect and differentiate diseased and health animals, it is important that each and every animal passes through crushes at the gate of the facilities.

- ❒ Each Phase I and II facilities need to have inspection crushes next to receiving pens along the entry into the pens and also at the end of the alley which leads to the loading ramp.
- ❒ Crushes must have an inner width of not more than 0.9 m.
- ❒ Crushes or races must be well maintained and kept free of loose objects.
- ❒ Must be so constructed to render the floors and drain covers non-slippery.
- ❒ The crush need to be well designed so that it has pre-inspection collection pen and also detaining pen for rejected animals.
- ❒ The section of the crush or race that leads directly into the loading ramp must have solid sides.
- ❒ To encourage entry, cattle should be able to see at least 6 m of unobstructed space beyond the crush.
- ❒ Flighty animals are more willing to enter a crush if the sides are covered, thereby preventing sight of the handler alongside. The use of solid sides also reduces the risk of an animal's leg becoming trapped between the crush supports.

8.3. Pens

- ❒ Must be so constructed and maintained to avoid injury of animals.
- ❒ Must have sides not less than 1.8 m in height for cattle and one meter for sheep, goats and calves.
- ❒ Must have a compact floors that are curbed and drained and non-slippery.
- ❒ Must be fitted with gates which are a minimum of 0.8 m wide for sheep, goats and calves and 1.8 m for cattle.
- ❒ Must be roofed where sheep or goats are kept.
- ❒ Must have well drained manure slabs for kraal manure prior to removal except if manure is removed directly into a vehicle.
- ❒ Isolation area for suspect animals must have solid walls and gate and must not drain across other pens or pose any other contamination risk.
- ❒ Pen rows should run parallel with the contour of the site to minimize pen to pen drainage.
- ❒ A smooth, consistent pen slope is very important in promoting the runoff of storm water. Pens should not be constructed with slopes of less than 2% as the drainage of rainfall will be ineffective. The ideal is considered to be 2 – 6%. As slopes increase there is a greater risk of transport of manure into the drains and sedimentation system after rainfall. It is preferable to harvest manure from the pens rather than the drains and sedimentation system where it takes longer to dry out and creates stronger and long lasting odors.

8.3.1. Pen size

Pen sizes generally vary according to the facility preferred management practices. Pen sizes in commercial feedlots commonly range from 50 to 250 head in capacity.

- ❒ A range of available pen sizes can be useful where different sized consignments are commonly received.
- ❒ Pen sizes can also be matched to transport arrangements, eg. 1 x 50 head pen per double deck trailer load.
- ❒ Pen depth should be restricted to a maximum of 65 m to limit the distance to feed facilities and minimize erosion.
- ❒ Pen depth should be decreased for steeper pen slopes to reduce the potential for erosion of the pen surface, e.g. 50 m maximum depth recommended for 6% pen slope.
- ❒ Pen width should allow sufficient room for ease of operation and cleaning.
- ❒ If cattle are being fed from open feed troughs, the pen width must be adequate to provide the required trough length for the number and size of cattle being fed in the pen. A smaller width per beast may be acceptable if cattle are fed twice or more times per day. However, a minimum of 150 mm/head is recommended for young cattle and 180 mm/head for older ones.

8.3.2. Pen orientation

Adverse climatic effects can sometimes be alleviated by studying the local climate, e.g. prevailing winds, and taking advantage of the local topography.

- ❒ A northerly aspect is generally desirable for maximizing exposure to the sun.

- ❒ If shade is likely to be installed at the facilities, either initially or at a later stage, a north-south orientation of rows of pens can generally make provision of shade structures easier.

8.4. Feeding shed

- ❒ Shade must be provided at each pen, which is especially important when sick animals are being held in pens for a few days until they recover.
- ❒ At a minimum, provide 1.9 square meter of shed space per head for about 3 percent of the herd. For example, a facility for a 100-head herd should include 5.7 square meter of shade (100 x 0.03 x 1.9).
- ❒ The most common shade materials are corrugated iron sheeting.

8.5. Feeding troughs

Self-feeder bins are commonly used in smaller and/or opportunity feedlots, whereas the majority of large, commercial feedlots use open troughs. Self-feeders generally only require filling approximately once or twice per week. They do not always perform well with moist rations or those containing a high proportion of coarse roughage. However they are not subject to the feed spoilage problems experienced with open troughs during wet weather. Depending on their design, manure and spilt feed can accumulate under self-feeders, creating an odor and fly nuisance, unless they are relocated and/or cleaned regularly.

- ❒ Feed trough length will depend on the number of cattle to be fed within the pen. More frequent feeding will allow the trough space per head to be reduced. A minimum of 150 mm for young cattle and 180 mm for steers is recommended.
- ❒ Feed troughs should be on the high side of the pens. Similarly, self-feeder bins should be placed near the up-slope end of the pens, with the long axis perpendicular to the fence.
- ❒ It is preferable for self-feeders to be filled from outside the pens to prevent any access problems during wet weather.
- ❒ Open troughs and self-feeder bins should incorporate 2.5 to 3.0m wide reinforced concrete aprons sloping away from the feed source.
- ❒ Phase I facilities must have hay feeder racks.
- ❒ Feed troughs should be constructed of durable material which is not easily damaged and can not be moved by animals.
- ❒ They should have an internal profile which can be easily cleaned, and the external sides should meet the ground at right angles. To prevent manure and spilt feed accumulating beneath the trough and to improve the ease of cleaning, troughs should have vertical external sides.
- ❒ The bed of the trough should be 175mm above the level of the apron to facilitate a natural feeding stance, particularly after a layer of manure builds up on the apron.
- ❒ The ends should be open, and long runs of troughs should include drainage points to allow drainage after rainfall.
- ❒ The inside surfaces of feed troughs should be smooth with well-rounded corners to facilitate easy cleaning.

8.6. Water troughs

Water is the most essential nutrient for life, being necessary for most body functions. It is used by animals for digestion and metabolism as well as respiration and cooling. Access to an adequate supply of good quality water is, therefore, essential for the survival, welfare and performance of the animals in the facilities.

- ❒ Generally need to provide at least 30 mm of trough length per head.
- ❒ Water troughs should have a height of 0.9 m for cattle and 0.3 m for sheep and goats.
- ❒ Low volume shallow troughs are preferred to reduce the flushing volume generated during regular cleaning operations. A good quick supply of water is essential for low volume troughs.
- ❒ Water troughs should be in the lower half of the pens, with provision for any spillage and water discharged during cleaning to drain directly to the drainage system to avoid creating wet spots. This may be done by locating the drainage bung in the bottom fence of the pen, or installing an underground sewer drain, or a concreted surface drain to convey the water away from the pen.
- ❒ Water troughs should have vertical external sides which meet the ground at right angles to prevent manure accumulating beneath the trough.
- ❒ A solid frame (steel or timber frames) should be constructed over the trough to prevent cattle climbing in.
- ❒ Unless animals are of same health status, troughs should not be shared between pens to avoid disease transmission.
- ❒ Desirable to have trough close to lower end of pen to reduce pen bogging following trough cleaning or tap failure.
- ❒ Alternatively, underground sewer pipes or a concreted surface drain can be provided to convey cleaning water away from the pens.
- ❒ The water source should not be close to the feed source, to avoid more feed is deposited in the water trough or vice versa.
- ❒ Troughs should have vertical external sides to prevent the accumulation of manure and to improve the ease of cleaning.
- ❒ Water troughs should incorporate 2.5 to 3.0 m wide reinforced concrete aprons sloping away from the trough at 2 to 3%.

8.7. Feed storage

- ❒ Animal feed store must be vermin proof.
- ❒ Should be constructed on the opposite side of the area where the isolation and recovery pens and emergency slaughter areas are located.

8.8. Fences, gates & lanes

By providing careful thought to the design and arrangement of fences, gates and lanes, ongoing cattle handling labor costs and injury of cattle and/or facility staff can be minimized.

- ❒ Phase I and II SPS facilities should be double fenced.
- ❒ The external fence should be fenced with 5 cm diameter wire mesh.
- ❒ There should be 10 meters distance between the internal and external fences.
- ❒ The internal fence can be made from concrete tree poles with horizontal tree pole reinforcements sufficient to prevent animals from passing through.

- ❒ Fences, gates and lanes should be designed to enable efficient movement of cattle and cleaning machinery.
- ❒ Lane widths of 4.8 m have been found to operate successfully.
- ❒ Tight turns should be avoided wherever possible.

8.9. Isolation pens (sick & recovery)

Sick animals can be held in special pens, separated from their congeners, to facilitate veterinary inspection or treatment.

- ❒ Isolation pens should be sited and constructed in such a way that waste and effluent from them cannot contaminate adjacent pens in the facility or passageways.
- ❒ Isolation pens should have separate drainage systems.
- ❒ Isolation pens should be away from the main passageways used by people and animals.
- ❒ The pens should have separate facilities such as water and feed troughs.
- ❒ The distance between an isolation pen and the rest of the facility shall be at least 60 meters.
- ❒ Sick and recovery pens can be constructed adjacent to each other for an easy transfer of convalescent animals.
- ❒ The sick pens have a minimum space allowance of 14 m^2 per head.

8.10. Emergency slaughter pen

- ❒ All facilities must have well separated areas to slaughter and dispose animals which are suspected to be affected with trade sensitive disease(s).
- ❒ The facility should be fitted with carcass burning pit.

8.11. Foot bath

- ❒ Each Phase I and II SPS facilities should have 0.5 x 1.5 m foot bath made of 10 cm thick mass concrete along the following alleys.

    - At the end of the crush after animals are received.
    - Along the feeders alley.
    - Along the exit alley from the recovery pen.
    - At the gate of the entry into the facility compound, offices and feed stores.

8.12. Loading & unloading ramp

The critical angle at which cattle start to slip on solid flooring is 22^0.

- ❒ The reception and shipping areas should have offloading and loading platforms, respectively.
- ❒ The length of the platform should correspond to the total length of all trucks. Docks of different heights or adjustable ramps should be provided to accommodate vehicles of varying heights.

- ❒ The unloading facilities shall be so constructed that unloading can be carried out without having a gap between the vehicle and the unloading dock. The sides of any ramps should be high enough to prevent the escape or injury of animals. Ideally, the unloading dock area should be leveled.
- ❒ The platform should slope at the ends to ground level of not more than 8%.
- ❒ Unloading ramp should have a horizontal docking area approximately 1.5m long to prevent cattle from slipping as they step out of the transporter.
- ❒ It is not advisable to build a loading ramp wider than the vehicles likely to use it.

8.13. Effluent management system

- ❒ There should be a sedimentation system where the base should be constructed from compacted gravel to enable cleaning operations to proceed under wet conditions. Basin embankments and beds should be impermeable to prevent seepage of effluent into ground or surface water resources.
- ❒ Holding ponds should be constructed so as to ensure impermeability.

    - A cut-off trench and compacted clay core are generally required beneath and within the embankment respectively.
    - The embankment crest width should be at least 3 m.
    - The upstream and downstream batters should be no steeper than 1 in 3.5 and 1 in 2.5, respectively, if clay construction materials are used.
    - A by-wash should be provided to ensure that the embankment is not overtopped following extreme rainfall events.

8.14. Manure management system

- ❒ Manure stockpile areas should incorporate a stable compacted base to enable manure handling operations to proceed under wet weather conditions.
- ❒ Manure stockpile areas should be established within the facilities along the controlled drainage area and with a regular 1-3% slope.
- ❒ The foundation of the area should be prepared to the same specifications as the facility pen foundation, and the surface should be finished with a layer of compacted stones to ensure all weather access.
- ❒ The manure stockpiles should be constructed up and down the slope of the area, not across the slope. This will assist drainage.

8.15. Office

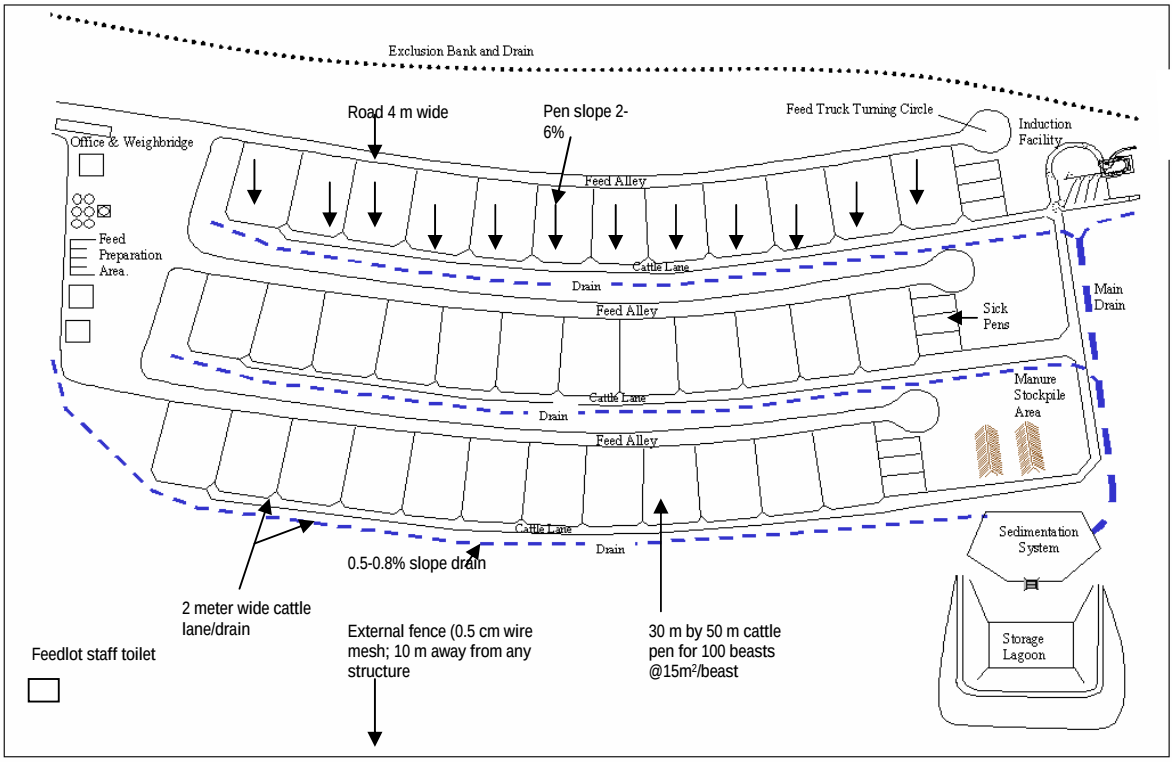
- ❒ Phase I and II facilities should have adequate offices accommodations for operators and government inspectors.

8.16. Reservoir deck

- ❒ Phase I and II SPS facilities should have water reservoir tank of at least 5 and 10 m^3 capacities, respectively.

Annex 1. Feedlot configurations

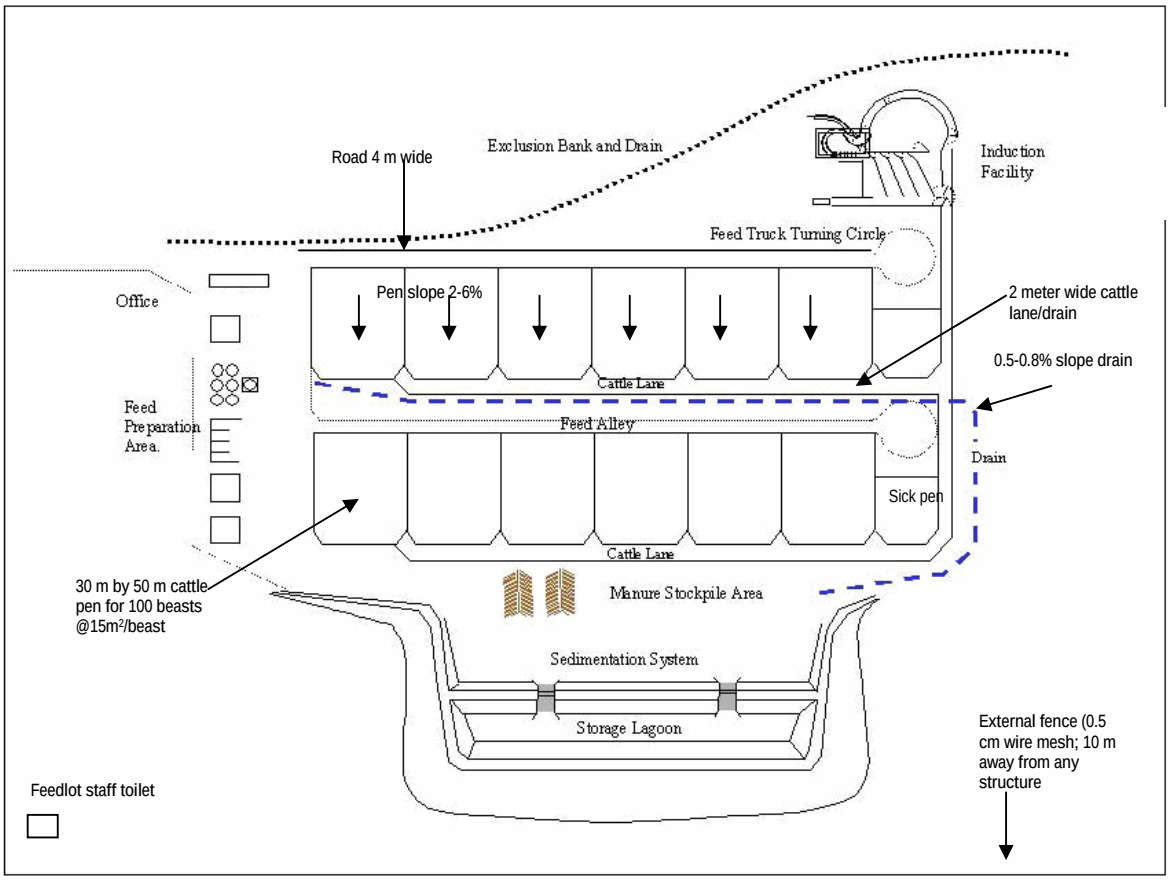
Figure 1. Type 1 - Typical Round the Hill cattle feedlot configuration (3600 heads)



Characteristics

- Suitable for hilly sites with natural gradients of 2 to 4%.
- Parallel rows of pens wrap around the natural contours of the hillside.
- Feed alleys enter from one side of the rows while drains and cattle lanes exit from the other side.

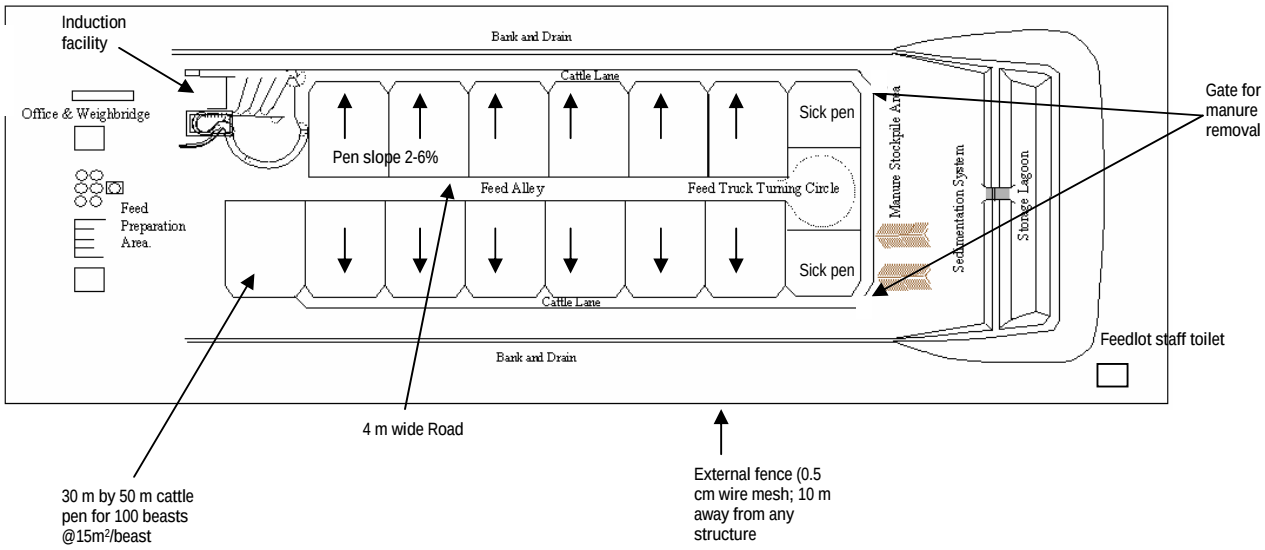
Figure 2 Type 2 - Typical Sawtooth or Terraced cattle feedlot configuration (1200 heads)



Characteristics

- Similar to Type 1 except that rows of pens are straight.
- Simpler construction and easier distribution of feed into troughs than Type 1.
- Best suited for sites with uniform natural gradients of 2 to 4%.

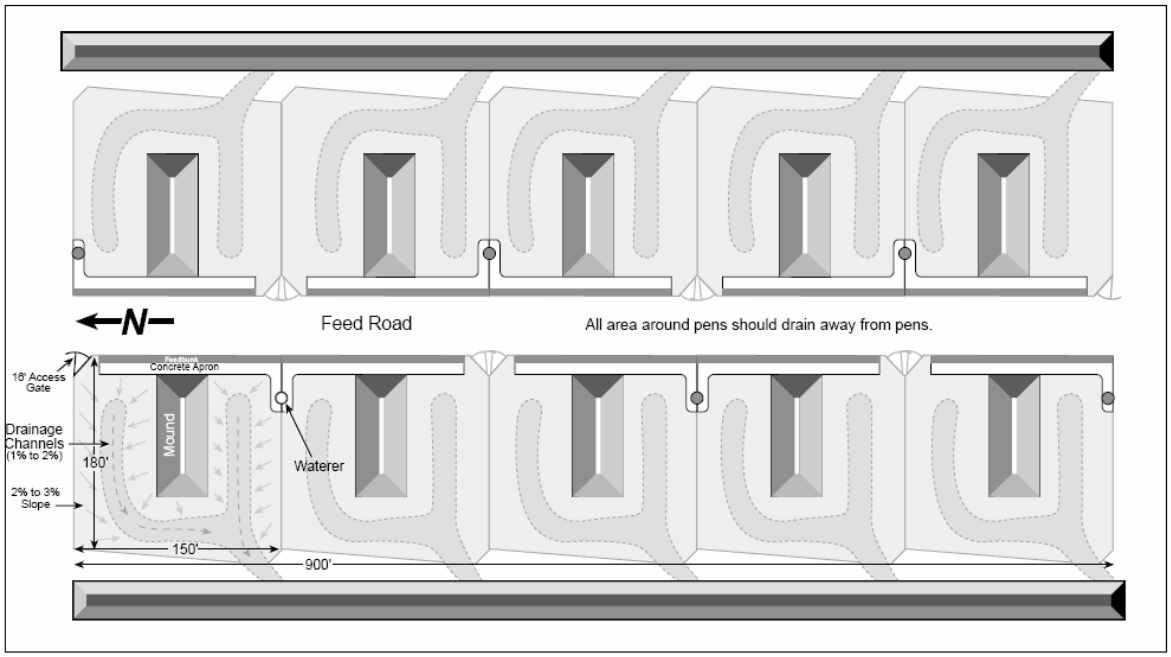
Figure 3 Type 3a - Typical Back to Back cattle feedlot configuration (1300 heads)



Characteristics

- Straight rows of pens with each feed alley and drain servicing the adjacent 2 rows of pens.
- Suitable for flat sites (natural slope <1%) where earthworks are required to create pen slope.
- The fill material required for the construction of the pen foundations is generally excavated from the retention ponds.
- Earth excavated from pond is used to construct pen area.

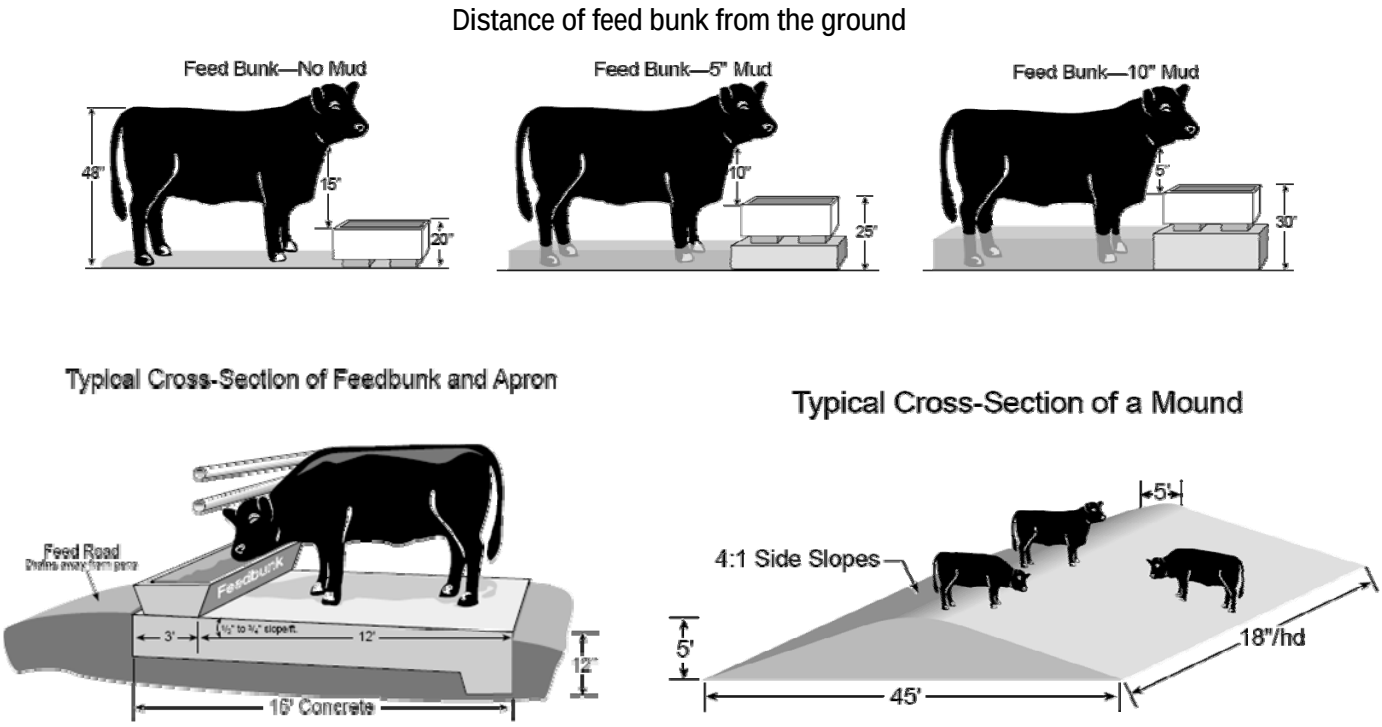
Figure 4 Type 3b - Back to Back cattle feedlot pen, feed bunk, apron and mound configuration (1000 heads)



Description

- Pens are arranged using a single or double row arrangement.
- A double row arrangement requires locating the pens along a ridge with lot construction on both sides of the feed road.
- A single row arrangement typically has feed bunks located on one side of the road and a diversion channel on the other side to carry away extraneous drainage.
- Often, a single row arrangement is used for operations with less than 800 head and may follow a terrace around a hillside. An advantage of the single row arrangement is only one runoff control structure is required.
- With a double row arrangement, the runoff must be contained from both sides of the ridge using either two structures or channels to bring the runoff back to a common lagoon. An advantage to the double row arrangement is the cost of the feed road is distributed between two pens rather than one.
- In larger operations, a wider feed road may be required and thus the cost savings are not as prevalent.

Figure 5 Feed bunk and mounds



NB: ' = foot; '' = inch

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