

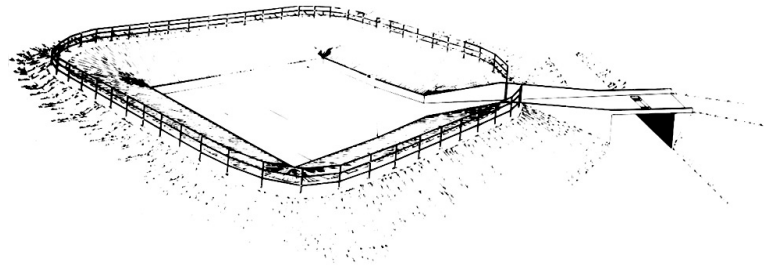
## EARTH BANK STORAGES FOR DAIRY MANURE

In areas of low annual precipitation and low groundwater tables, earthen basins can provide long-term storage of manure at costs that are considerably lower than either steel or concrete pits. If properly planned, designed and managed, earthen storages will not create pollution or nuisance problems. Generally, earthen basins should not be considered in high precipitation areas, in areas with high groundwater tables, or over sand, gravel, fractured bedrock, and soils having high permeability.

### SIZE OF STORAGE

Dairy producers should plan on providing storage for at least 200 days to make efficient use of the fertilizer value of manure and to facilitate good labour management. To avoid water pollution problems, manure should not be spread on snow-covered or frozen ground. If 200 days of storage are to be incorporated, the basin should be designed to provide 425 cubic feet of capacity for every mature dairy cow and 170 cubic feet for each of the younger stock. If storage for parlour wastewater is required, an additional 210 cubic feet of storage capacity for every milking cow must be provided. To account for precipitation, the size of storage must be increased by an amount equal to the anticipated 6-month precipitation (in metres or feet) multiplied by the surface area of the basin (in square metres or square feet). As a rule of thumb for most areas of North Central BC and the Kootenay Region, the storage capacity should be increased by approximately 20% to account for precipitation. Where storage for longer than 200 days is planned, evaporative losses will partially offset dilution by precipitation. In all cases, at least one foot of freeboard space should be included when calculating the capacity of an earthen basin.

More detailed information on sizing dairy manure storage structures is given in the BC Ministry of Agriculture factsheet #383.100-2 entitled *Sizing Dairy Manure Storage Facilities*. Further information is also available in the BC Environmental Farm Plan Reference Guide.



**Figure 1** Semisolid earth bank storage. Note the curbed concrete floor and the unloading ramp. Manure is dragged up the ramp with a tractor scraper and falls through the grate into an open-top spreader.

### SEMISOLID MANURE STORAGES

If dairy wastewater is not added to the manure in the storage and if some bedding or long hay is being used, the most appropriate method of handling the manure may be in a semisolid form. Manure may be transferred to storage directly by a tractor scraper, via barn cleaners and elevators, or by positive placement pumps. Pumps are the preferred method for moving liquid manure into an earthen storage. Although more expensive, a pump system permits manure to be moved longer distances to storage, eliminates problems of frozen manure in barn cleaners, and facilitates the introduction of manure into the storage from the bottom. Manure and snow do not become mixed, making it possible to empty the storage much earlier in the spring than if barn cleaners are used.

Semisolid manure can be removed from storage using front-end loaders, sludge pumps or ramps. Because tractor access into the basin is essential for cleaning purposes, the basin should have a concrete floor surrounded by a two-foot-high curb. Where front-end loaders are to be used, it will be desirable to drain as much of the liquid portion of the manure out of the storage as possible, but the effluent drained off must be contained properly so as not to create a pollution problem. Porous fences are one method for removing liquids into an adjacent storage basin but their use is typically not practical where annual precipitation is less than 750 millimetres (about 30 inches).

Specialized ramps have been used for some time in the province for loading spreaders from semisolid manure storages. With this system, a tractor with a rear-mounted scraper blade pulls manure up a ramp and over a grate through which the manure falls into a top-loading spreader. This system provides a low-cost efficient method for removing manure from storages.

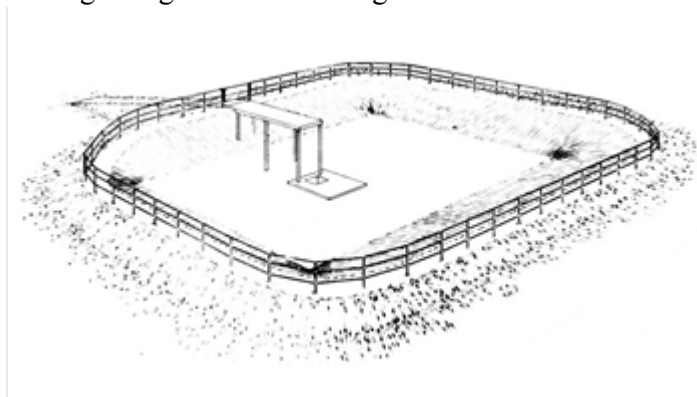
Some progress is being made by manufacturers to develop a pump to successfully handle undiluted dairy cattle manure. Consult local manure-handling equipment businesses for further specific information.

## LIQUID MANURE STORAGE

In situations where dairy wastewater is added to the manure and where the use of long hay and bedding is minimized, liquid handling of manure is possible. Liquid manure may be transferred directly storage with tractor scrapers or with pumps. Barn cleaners are not recommended for handling liquid manure due to freezing problems and the slowness with which manure is able to be moved, particularly in elevator sections. A number of good centrifugal low-head pumps or hydraulic piston pumps are available to transfer manure from a collection pit to the storage. As in the case of semisolid manure, piston pumps are likely the best choice if the storage is located remotely from the barn.

Manure stored as a liquid in an earthen basin must be agitated prior to its removal for land application. One or more pumping docks which extend out into the basin and upon which a tractor can be parked to

operate the agitation and pumping equipment are essential. A concrete pad at least ten feet square should be placed under the pump inlet to prevent scouring the bottom of the basin and to help prevent rocks and sand from getting into the pump. A one-foot-deep sump beneath the pump will allow more complete emptying of the storage. The use of open impeller centrifugal pumps to agitate the storage and to pump manure into a top-loading tanker wagon is most common. Where a vacuum tanker is used to haul and spread the manure, a tractor-operated propeller agitator is a good option for agitating manure in storage.



**Figure 2** Earth bank storage for liquid manure. Note the pumping dock upon which agitation and loading equipment will operate.

## STORAGE CONSTRUCTION

A manure storage basin is not just a hole in the ground. Soil characteristics must be evaluated prior to construction of the basin. In general, earthen storages should be constructed only where the subsoil contains enough clay to make a manure-tight seal. Common side wall slopes are 2:1 (two feet of run for each one foot of rise) on the inside of the berm and 3:1 on the outside. Steeper slopes may result in erosion and dyke instability whereas shallower inside slopes increase the area required for the storage and result in manure hanging up on the walls during emptying. A good grass cover should be established as soon as possible after construction on the top and outside of the banks.

Drawings detailing earthen basins for liquid and semisolid handling of manure are available from the B.C. Ministry of Agriculture.

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### FOR FURTHER INFORMATION CONTACT

Phone: 604.556.3001  
Toll Free: 1.888.221.7141

### MINISTRY OF AGRICULTURE

1767 Angus Campbell Road  
Abbotsford, B.C. V3G 2M3